ENGINEERING NEWS.

Tribune Building, New York City.

GEO. H. FROST, PROPRIETOR.

SATURDAY, MAY 21, 1881.

REMOVAL.

The offices of this journal have been removed to No. 16 Tribune Building, where we will be pleased to receive our friends whenever they come to New York. Our office heretofore has been in the old portion of the building, fronting on Spruce Street. We are now located in the main building, fronting on the City Hall Park, and we think that we have the finest suite of offices that can be exhibited by any class journal in the country. Call and see us.

PERSONAL.

Walter A. Osmer has been re-elected for his third term as City Engineer of Logansport, Ind.

Thomas A. Hodge has been appointed Superintendent of the North Adams (Mass.) Water-Works.

Mr. L. M. Clement, late Superintendent Track C. P. R. R. and leased lines, is now Chief Engineer Atlantic & Pacific Railroad.

Messrs. Rust & Coolidge, engineers and contractors, have removed their office in Chicago to Rooms 37, 38, 39 and 40, Grannis Block, 115 Dearborn st.

Recent surveys by Mr. E. S. Nettleton make the height of Pike's Peak above the sea to be 14,137.7 feet, and the Colorado Springs *Gazette* believes this estimate to be the most accurate ever taken of any peak among the Rocky Mountains.

The Board of Dominion Land Surveyors, consisting of Surveyor General Russell, B. Magrath, Captain Deville, and Captain Lang, Secretary, examined the candidates for certificates as Dominion land surveyors this week at Ottawa, Ont. There are eighteen candidates.

It may not be uninteresting to some one to know that the location of the Rocky Mountain Division of the Northern Pacific Railroad is in charge of Col. J. T. Dodge, who has four parties in the field making surveys. The assistant engineers in charge of parties are C. W. Keith, G. D. Chenoweth, J. I. Van Vliet, and E. H. Beckler.

Arrangements are now being made for the organization of a society of civil engineers and surveyors in the State of Minnesota. The preliminary meeting will be held in the City of Minneapolis in September next. Information in regard to it may be obtained from M. B. Haynes, City Engineer, Mankato, or Geo. W. Cooley, C. E., Minneapolis.

CITY OF MEXICO, May 12.—H. H. Filley, for the shooting of Sackrider, at Merelois, is under the supervision of the police. Sackrider killed Augustus Martin and Granville Jones, engineers, and Filley killed Sackrider in self defense. Sackrider was insane, and tried to kill the whole party. Martin was an American of Cuban extraction, and resided in Philadelphia; Jones was an Englishman, and Sackrider a Pole.

The Minister of Agriculture has issued instructions to Col. W. Milnor Roberts to make an examination of the ports of Rio Grande do Sul with reference to their improvement. This work, especially with reference to the Rio Grande bar, is one of great urgency. Col. Roberts is now making an examination of the ports of Victoria and Benevente, province of Espirito Santo, after which he will examine the port of Caravellas.—*Rio News, April 24.*

A. B. Mullett, formerly U. S. Supervising Architect, and Mr. Hugo Kafka, as architects, have formed a copartnership with Wm. G. Steinmetz, City Engineer of Brooklyn, and Albert F. Hill, C. E., a well-known wire and steel expert, as civil engineers. The double firm is known as Messrs. Mullett & Kafka and Steinmetz & Hill; the offices are at 234 and 235 Broadway, rooms 42 to 46. Messrs. Mullett & Kafka will attend to the architectual branch of the business, while Messrs. Steinmetz & Hill will take charge of the constructive work. Mr. Hill, while having his office as above, remains Consulting Engineer for the Siemens-Anderson Steel Works, as heretofore.

NEW YORK ASSESSMENTS.

A board of citizens, specially competent to discharge the duty in this city, is charged with the revision of various assessments for street grading, paving, sewers, and other public improvements, made under the corrupt régime which disgraced New York and existed in other large cities, as one of the results of the war. These gentlemen are Hon. Edward Cooper, Allan Campbell, Geo. H. Andrews, Daniel Lord, Jr., and John Kelly.

Last week two sessions were held on the Sixth and Seventh avenue grading and paving assessments, which amounted to $686,752.74 on Sixth and $1,217,530.86 on Seventh avenue. Messrs. Chas. E. Miller and Jno. C. Shaw appeared as counsel for the property owners and Asst. Corporation Counsel F. A. Beall for the city. Several witnesses were examined. Mr. McElroy's testimony, as an expert, puts the value of the work at $319,753.42 for Sixth and $802,718.57 for Seventh, if done as independent work, and at $248,832.01 for Sixth and $680,374.62 for Seventh, if done with a proper regard to the relative surplus of Seventh avenue, and the deficiency in quantities of Sixth, in a case where the same department had full control of the work on both streets.

The manner in which, during what may be termed the "dark age" of the profession, specifications were drawn and work arranged to favor certain contractors and frighten off honest bidders is illustrated in cases of this kind. On the correct theory that waste rock, filled in as the base of a street, where it abounds in upper New York, should not be dumped in huge masses, which cannot be made water-tight, cannot be drained, are constant receptacles of water and possible creators of malaria, the usual city specifications limit the size of such rock to cubes of two feet face; in the strictly virtuous contracts of Sixth and Seventh avenues this is reduced to one foot. Yet an inspection of the work shows the most reckless use of huge masses, in some cases about five feet long. The usual specification, for an obvious reason, limits the level of such fill to four feet below street grade; but at five feet in this case, practically, in some cases, less than three feet, in the work.

It is customary in contracts to give contractors the material on the work, suitable for construction, and for construction only. On Seventh avenue there was a rock surplus, near the Harlem River, of over 200,000 yards. For wall foundations, crib-filling, and like purposes, this stone in 1872 was worth, on a barge, one dollar a yard, and a large amount of it was sold then at this price. But the assessment rolls show no allowance to the property owners for this valuable material, and the contracts were so administered that they were charged with the cost of excavation and removal as grading, and of re-excavation and haul, for that portion used in the pavement.

The usual pavement specifications require trap rock for the six-inch layer of macadam, which overlies the 8-inch foundation of Telford pavement. In a case where there are four inches of trap rock and gravel dressing at the surface, and in a district where hard gneiss abounds, the intention of such a specification is obvious.

As the profession gradually purifies itself, and the history of transactions like these goes on record and determines relative standing, property owners and public works will reap the advantage.

THE NEW YORK AND BROOKLYN BRIDGE.

(*Continued from page* 192.)

BLASTING.

When the caisson had arrived at the depth of 25 feet below the water level, the boulders became so large and numerous that blasting was necessary. Although the idea of using powder had been entertained all along, it had not yet been attempted, as it was supposed the effect of the explosion in that dense atmosphere would produce a violent concussion, rupturing the ear-drums of the men. The principal apprehensions were, however, directed toward the water-shafts. There were two columns of water, seven feet square and ultimately 45 feet high, held in a critical balance by the inside pressure, the margin of safety being an immersion of less than two feet on the part of the lower edge of the shaft in the pool surrounding it. The sudden explosion might rapidly lower the level of the pool and allow the air to escape beneath, which would be fatal both to the men and the caisson.

Actual experience justified none of these fears. First, a trial was made by firing a pistol with successively heavier charges, then small charges were fired by a fuse, and soon blasting became an established system. The good effects were at once apparent in the lowering of the caisson from twelve to eighteen inches per week in place of six inches. As many as twenty blasts were fired in one watch, the men merely stepping into an adjacent chamber to escape the flying fragments. One convenient way of disposing of boulders under the shoe was to drill a hole through them, plant the charge at the bottom, and shoot them bodily into the caisson where they were broken up at leisure.

THE WATER SHAFTS AND BUCKETS.

All the material in the caisson was removed through the water shaft by the Morris and Cummings grapnel bucket, an instrument which is analagous to the human hand in its action. It is lowered down the shaft by means of two ropes, in an open position; at the bottom it closes over the material, filling itself at the same time. It is then drawn up and its contents emptied into a car. The estimated efficiency, making all due allowances, was 800 yards per day. The total quantity of earth removed was over 20,000 yards, the time required being five months.

When the shaft was 45 feet high the water in it held seven feet of clay in suspension, and the column of water, instead of being 45 feet high, to correspond to a pressure of 20 pounds per square inch, would have a height of only 30 feet, showing that the mixture weighed some 90 pounds per cubic foot instead of 63. When the shaft was idle for a short time, this mixture would settle at the bottom and outside of it; at the same time the lightened water column would rise, requiring a fresh supply below. Constant attention was required not to let the water supply get too low.

DUMPING CARS.

Two kinds of dumping cars were used; one style being provided with a turn-table for dumping the load at any point; the other and preferable kind dumped on rockers and required less attendance. (See Plate I.) The cars were hauled back and forth by steam power. Part of the dirt was used to fill a vacant slip at the rear of the caisson. The bulk of the stone was saved and subsequently used for filling up the air chamber.

The remainder of the material was dumped directly into the river and redredged, this plan being found cheaper and quicker than direct dumping into the boats. The cars several times fell into the shafts but were easily picked out by the dredges.

MANAGEMENT OF AIR PRESSURE.

At the beginning the air pressure was governed entirely by the tides, and regulated itself according to their height. The tightness of the caisson was quite satisfactory, and it was soon found that during the falling of the tide it was practically unnecessary to run the pumps, as the loss of head counterbalanced the leakage. But with a rising tide the pumps had to be run at full speed. A declining pressure was always attended by a thick fog, which lasted until the tide changed, when the caisson would remain clear for the next six hours. These fogs could not be entirely overcome, although pumping in an excess of air partially dispersed them. Every change in the air pressure produced either a rise or fall of the column in the water shaft, and constant attention was required to prevent a blow-out from the lowering of the water in the pool, or a washing away of the dam surrounding the pool. A fixed pressure was maintained according to the calculated head of water.

BLOWING OUT OF WATER SHAFT.

As the caisson was sunk, much of the dirt coming out was dumped on top of it, filling up all spaces not occupied by masonry. This was only the beginning of the over weight to be carried ultimately. At very low tide the over weight was equal to a volume of water weighing 3,700 tons.

The over weight kept slowly increasing until one Sunday morning every particle of compressed air blew out through the south water shaft, leaving the caisson in an instant. The immediate cause was the washing away of the dam surrounding the pool under the shaft, and was the result of carelessness. There was no man in the caisson at the time, so that experience in that direction was lost. Eye witnesses outside stated that a dense column of water, mud and stones was thrown 500 feet into the air, the accompanying roar being terrific. The noise was so frightful that the whole neighborhood was stampeded and made a rush up Fulton street, even the toll collectors at the ferry abandoning their tills.

It was all over in an instant. Both doors of the air lock fell open, and the dry bottom was visible through the air and water shafts; not a particle of water had entered under the shoe. As soon as possible a stream of water was passed into the shafts from above, the locks were closed, and in the course of an hour the pressure was restored to fifteen pounds.

The total settling that took place amounted to ten inches. Every block under the frames and posts was absolutely crushed, the ground being too compact to yield; none of the frames were injured nor even out of line. The brunt of the blow was taken by the shoe and sides of the caisson, and in some places the latter were forced in some six inches. The air tightness was not impaired in the least. The nine courses of timber forming the sides of the air chamber were permanently compressed to the extent of two inches, as was shown by protruding bolt-heads and the shearing off of a number of diagonal bolts.

The weight of the caisson at the time was 17,675 tons. The air blew out so suddenly that this weight must have acted with considerable impact in falling through the space of ten inches. The total bearing surface at the time was 382 square feet; the pressure being at the rate of 46 tons per square foot. But as one-half of the shoe was undermined to a depth of one foot, the pressure was at least 80 tons per square foot, no addition being made for impact. The shoe had buried itself so as to present a width of 12 inches, and the settling had ceased when a bearing surface of 775 feet had been reached, giving a pressure of 23 tons per square foot. The ultimate pressure on the base of the caisson, due to the weight of the tower and superstructure, will be only five tons per square foot, hence the margin of safety against crushing is ample.

Subsequent examination showed that the roof of the air chamber had assumed a permanent average depression of four and one-half inches, being least in the end chamber and greatest near the water-shafts, where there was the least support by frames, and where the openings had cut the timber through from top to bottom. This deflection never increased.

ADDITIONAL SHORES.

As the caisson proceeded on its downward course, the disproportion between the dead weight above and the air pressure below became greater and greater; and in order to meet this overweight a large number of additional shores were introduced, which rested upon a block and wedges, and supported a cap spiked against the roof. These shores added considerably to the labor of lowering the caisson, and diminished the available working space. They gave, however, a positive assurance against any crushing from above, and could be readily removed when a boulder was to be taken out.

The crushing of the blocks under the posts was the only indication that any portion of the caisson was bearing particularly hard.

BRICK PIERS.

When the caisson had arrived within three feet of its proposed resting place, it was considered advisable, while the air chamber was being filled with concrete, to erect for its support seventy-two brick piers, systematically located, and averaging twenty square feet of base. Their capacity was just sufficient to support the whole weight above in case the air blew out. The piers were completed in three weeks, 255,000 bricks being used in their construction.

BLOWING OUT OF SUPPLY SHAFT.

Shortly after the caisson had come to a bearing on the piers and the concreting had been in process a fortnight, one of the supply shafts blew out. The pressure of the air was reduced in a few minutes from eighteen to four pounds, and the piers had to bear the brunt of the weight.

The supply shaft consisted of a tube 45 feet long and 21 inches inside diameter, with a door at the bottom opening into the air chamber, and a long door on top through which material was thrown in. When the upper door was open, the lower one was held shut by the air pressure assisted by two iron clamps worked by levers. As soon as a certain quantity of material had been thrown in, the upper door was pulled up, and the compressed air being admitted, it was held firmly. When the shaft had become filled with compressed air, the attendant below was signaled, when he removed the lugs, the door fell open and the contents dropped into the chamber. Two of these shafts were found ample to furnish all the material for filling up the caisson. It sometimes happened that a load of stone or brick would become jammed and only a portion fall out. To ascertain if the shaft were clear, a string with a weight was let down from above. Upon this occasion a charge had jammed; the men dumped in another without measuring the depth, and then gave the signal to the man below, without shutting the upper door. The second charge loosened the first and the two together overcame the pressure against the lower door, when the lugs were turned. As soon as this happened the air rushed out of the caisson with a great noise, carrying stone and gravel with it. The men above ran away leaving those below to their fate. The upper door could have been closed by simply pulling the rope. Those in the caisson set to work removing the pile of stone from beneath the shaft so that the lower door could be closed. This required but a few moments, when all was again secure. The great weight did not affect the piers, although subjected to a pressure of 12 tons per square foot.

The sudden lessening of the pressure had no more effect upon the human system than that experienced in passing out through the air lock.

(TO BE CONTINUED.)

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 184.)

PROVIDENCE—(CONTINUED).

The first public water supply introduced was in 1772, when a company was incorporated by the General Assembly to supply that part of the town, since called Eddy's Point, but which was then an island with fresh water drawn from a spring, and carried by log pipes from the mainland for a distance of three-quarters of a mile, the capacity of the pipes being 125,000 gallons per day.

The water was introduced in April, 1772. In October of the same year "Rawson's Fountain Society" was incorporated, which supplied from springs, a reservoir 30 ft. long, by 13½ ft. wide and 10 ft. deep, from which a 4-in. wooded main, 6,600 ft. long, conveyed the water.

The Providence Aqueduct Company was also incorporated, and it built two fountains; one was located near the junction of the present Stewart and Conduit streets, and water was conveyed from it in two 4-in. iron pipes, which in some places were laid as low as 31 ft. below the surface of the ground.

They were carried across the river below its bed, but in the construction of a bridge were broken and never replaced.

The other fountain was located between Fountain and College streets, and a little east of Dean street. The main was a 3-in. iron pipe, and the head was sufficient to deliver water into the third story of the highest building. All of these fountains were used to supply the people of the west side of the river. They were owned by different companies, who supplied water at about $10 for each family per annum.

In 1803 Col. Jeremiah Olney undertook to furnish fresh water from a spring in his own land, to the people of the east side, but after laying log pipe for some distance, he discontinued the scheme, as on account of the ease of getting water from the wells on their premises, the people gave him no encouragement to proceed.

MONTREAL.

Montreal, in Canada, is in lat. 45° 31′ N., long. 73° 35′ W., on an island formed by the delta of the Ottawa River at its confluence with the St. Lawrence. The city lies on a gentle slope to the foot of the mountain whence it derives its name, which rises on the island to a height of 750 ft.

Founded in 1642 by the French, its population in 1801 was about 10,000, when the "Company of Proprietors of the Montreal Water-Works" was incorporated with a capital of £8,000, and water was obtained from springs on the mountain and conveyed in wooden pipes around its southern slopes to two reservoirs.

From deficiency of water, the works proved a loss, and the rights were sold in 1816 for £5,000. The new company took up the wooden pipes and replaced them with 4-in. iron pipes, abandoned the mountain springs, established steam engines on the site of the present works, and pumped water into wooden cisterns on Citadel Hill. The wooden cisterns failed in 1827, and were replaced by others lined with lead, and 97 ft. above the river. They held 240,000 gallons.

*Copyright, 1881.

The 4-in. pipes proved insufficient, and the franchise was sold again in 1832 for £15,000.

The principal mains were replaced by 10-in. iron ones; the engines were removed and others added.

In 1843 there were in use 3 engines.

One, capable of raising 40,000 gallons per hour, was used for pumping and grinding grist. The second, capable of pumping 53,000 gallons per hour, was used solely for pumping, and the third for drawing lead pipe.

To Feb. 1, 1843, 14 miles of pipe had been laid. The company kept 3 taps for sale of water to carters, and had 16 fire plugs of their own. About £10,000 was expended by this company.

In April, 1845, the city purchased the works for £50,000. In 1845 a conduit was extended from the pumps into the river as far as deep water.

In 1849 a reservoir was built at Côteau Baron, 139 ft. above the river. Its capacity was three million gallons. It was used for several years, but became of no value for distribution and was abandoned about 1876.

In 1850 the laying of a large amount of distribution pipe was ordered. In May, 1853, the construction of new works was begun after the plans of T. C. Keefer, C. E., indorsed by W. J. McAlpine and J. B. Jervis.

The water is taken from the St. Lawrence River, about a mile above the Lachine Rapids, where its elevation is 37 ft. above the summer level of Montreal harbor, and is conducted 1¾ miles in an open channel 20 ft. wide on the bottom and 40 ft. on top, and 8 ft. deep, with a grade of 2½ in. per mile, to the Lachine Canal, where pumps, operated by two breast wheels of 20 ft. diameter and 22 ft. wide, under 20 ft. head and fall, forced the water to a reservoir 200 ft. above the harbor, on McTavish street, holding 15 million gallons, and the reservoir at Côteau Baron.

The aqueduct and wheels were put in operation in the fall of 1856, and the consumption then was about 2 million gallons.

1857 it was	2.5	million gallons.
1858 "	3.0	" "
1863 "	4.0	" "

Up to 1859 one wheel sufficed. In 1859 the full work of one wheel and that of another for a few hours was necessary.

After 1860 the backwater and anchor ice caused a great deal of trouble, and in 1861 and 1862 water carriers had to be employed to carry water to the upper part of the city.

For several winters a channel had to be cut through the ice in the entrance to the aqueduct.

The deepening of the entrance in 1863 relieved the trouble from anchor ice, but ice in the aqueduct reduced its winter capacity to one-third of its summer capacity.

Sections taken of the aqueduct in 1866 showed that the area was very considerably reduced over a large portion of its length, by slides in the banks. The original sectional area was 325 sq. ft., which had become reduced to from 269 to 320 sq. ft.

The construction of the Victoria Bridge and the narrowing of a portion of the river thereby soon after the plans of the water-works were made, but before the completion of the work, obliged the wheels to be raised 2 ft. higher than was originally intended, and consequently lessened their efficiency. A turbine wheel was added in 1864.

An enlargement of the McTavish street reservoir was begun in 1862, but was not completed until 1878. For twelve years the work was done in great measure by the Street Department, excavation of rock being made only as it was wanted for paving; but in 1874 more active measures were taken.

The reservoir as completed holds 43,000,000 U. S. gallons.

A high-service reservoir was built in 1875 at the head of Peel street, 200 by 80 ft. and 10 ft. deep. It is 230 ft. above the McTavish street reservoir, and is supplied by a Worthington engine of 5 million gallons capacity placed at the latter reservoir.

The construction of a new aqueduct canal after the plans of Louis Lesage, as approved by Wm. J. McAlpine, was begun in 1874. The new canal is 60 ft. wide on the bottom and 13 ft. deep, with side slopes of 3 to 1. The gradient of the bottom is 3 in. to the mile.

The entrance is placed at a point where there is a considerable eddy or bay of still water, which it is hoped will prevent injury from floating ice in the river, and also the formation of anchor ice.

The first section of the new canal, 4,800 ft. long from the entrance to a point of intersection with the old canal was completed in October, 1878. A boom of squared timber was placed across the mouth of the bay at the entrance to prevent floating ice and drift from entering the canal, with satisfactory results.

The plans of the new work contemplate the construction of another canal parallel to the old one all the way to the pumping station. The necessity for its immediate construction has been obviated by the erection of another steam pumping engine.

When in 1868 the consumption had increased to such an extent that the water supplied by the canal was not sufficient for power and consumption also, a steam engine was erected, working pumps of 3½ million gallons capacity, and put in operation in July, 1869.

A second engine was put up in January, 1872. These are compound engines, with steam cylinders of 44-in. and 26-in. diameter. In 1873 a high pressure double-cylinder steam engine was connected to the turbine wheel to help it during the winter months when the supply was deficient.

A second turbine wheel was erected in 1874 in place of one of the breast wheels. In 1874 a Worthington engine of eight million gallons capacity was added.

The distribution pipes are of cast iron. More than half of them are of less than 6 in. diameter.

Meters began to be used in 1870.

There were 305 in use on January 1, 1881.

The population, pipeage and consumption have been as follows:

Year.	Population.	Miles of pipe.	Daily consumption in millions of U. S. gallons.
1860	90,000	....	3.28
1870	107,225	94.	6.86
1880	145,000	132.6	11.64

MONTHLY RATIO OF CONSUMPTION OF WATER.

City.	Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Average consumption per day, in millions of U. S. gallons.
Philadelphia	1879	1.11	1.12	1.11	1.11	0.95	0.90	0.89	0.88	0.89	0.94	0.99	1.12	54.5
Brooklyn	1880	1.00	0.99	1.03	1.04	0.94	0.88	0.97	0.95	0.97	1.14	1.13	1.03	30.7
Chicago	1877	0.87	0.95	1.05	1.37	1.30	0.99	1.03	0.89	0.90	0.93	0.88	0.99	52.2
Boston	1879	0.88	0.89	1.02	1.20	1.10	1.04	0.98	0.98	0.97	0.97	1.06	0.98	34.6
St. Louis	1879	0.86	1.01	1.10	1.16	1.01	0.96	0.92	0.87	0.98	0.97	1.17	1.09	25.0
Cincinnati	1880	1.25	1.26	1.19	1.14	0.97	0.95	0.88	0.86	0.82	0.87	1.06	1.00	19.5
Cleveland	1879	0.88	0.94	1.11	1.21	1.01	1.01	0.90	0.95	1.02	1.00	1.05	0.99	9.5
Buffalo	1879	0.94	0.94	1.01	1.11	1.08	1.05	0.98	0.96	1.00	0.99	1.00	0.97	14.5
Newark	1880	1.11	1.07	1.05	1.04	0.90	0.88	0.92	0.98	0.97	1.01	1.11	1.09	9.4
Louisville	1879	0.92	1.04	1.08	1.11	0.97	0.95	0.89	0.90	1.05	0.97	0.85	1.01	5.2
Detroit	1880	1.13	1.06	1.07	1.08	1.00	0.97	0.98	0.97	0.91	0.99	1.05	0.91	15.2
Milwaukee	1879	0.97	1.03	1.10	1.16	1.02	1.01	0.88	0.91	0.98	1.02	1.05	0.93	10.6
Providence	1879	1.10	1.06	1.20	1.30	0.96	0.89	0.82	0.88	0.93	0.92	1.07	1.05	3.1

City.	Year.	Population	Pipe.		Taps.		Hydrants.		Stop cocks.		Meters.
			Miles.	Inhabitants per mile of pipe.	No.	Taps per mile pipe.	No.	Hydrants per mile pipe.	No.	Stop cocks per mile of pipe.	
Philadelphia	1879	829,688	730	1,137	.....	...	5,819	8	.....	.....	30
Brooklyn	1880	566,689	363	1,520	60,555	169	2,854	8	2,237	6	850
Chicago	1877	439,976	424	1,035	64,448	152	3,002	7	2,701	6	1,623
Boston	1880	412,000	500	824	68,334	137	4,075	8	3,889	7	1,313
St. Louis	1879	347,017	200	1,733	18,999	94	1,716	8	1,887	9	.....
Cleveland	1879	153,411	126	1,217	9,285	73	817	7	1,856	14	284
Buffalo	1879	151,395	102	1,484	8,559	81	1,082	.....	.....	.....	.....
Newark	1880	136,400	136	1,003	10,965	81	....	.....	....	.....	150
Louisville	1879	121,356	110	1,103	7,225	66	19	.....	1,807	16	201
Detroit	1880	116,342	209	556	22,465	107	747	4	....	.....	17
Milwaukee	1879	111,165	86	1,292	6,835	79	673	8	476	5	.....
Providence	1879	101,256	152	666	8,656	57	1,116	7	....	.....	4,036

The works are managed by Louis Lesage, who has been the Superintendent and Engineer since 1853, and reports to the Water Committee of the Common Council.

XIX.—MILWAUKEE.

Milwaukee, Wisconsin, on Milwaukee bay and river, on the western shore of Lake Michigan, in lat. 43° 2′ N., long. 87° 54′ W. has an area of about 14 square miles. The banks of the lake and rivers rise in some places quite abruptly and in others with a gentle slope to an elevation of 150 ft. on the west, and 75 ft. on the east of the river. Two small rivers join the Milwaukee about a mile from its mouth.

Founded in 1835, the population in 1872 was about 75,000, when works for water supply were built after the plans of Moses Lane, C. E.

Water is taken from Lake Michigan by a cast-iron 36-in. pipe, with ball and socket joints, extending 2,100 ft. into the lake, 2½ miles from the mouth of the river.

The pipes were sustained above water and lowered as the work proceeded to their bed in the lake. The crib at the end of this pipe is a hexagon composed of several rows of oak piles filled between with heavy stones.

The length of an exterior side being 21 ft. and interior 8 ft., the exterior and interior walls being formed of two rows of piles driven close, the included space of 6 ft. being filled with stone. The top of the crib is 7 ft. above the lake surface. The piles are evened off, bolted, and the whole decked with heavy timber.

The crib end of the pipe is provided with gates so arranged that water can be drawn at pleasure from 4 to 12 ft. below the surface. The gate and openings are protected by screens of copper wire. The depth of water at the crib at ordinary low water is 18 ft. The pipe is protected by a pile bridge driven directly over it from crib to shore.

The engine-house is built to accommodate four engines. The pump well is 10 ft. wide and 28 ft. long, and is divided by cross-walls fitted with gates, so that the water can be pumped out of either well when the other is in use. The foundation of the well rests on two courses of oak timber; the first course, 12 in. square, laid close; the second, of 4-in. plank, spiked to the timber. Upon this timber foundation is laid a course of masonry 20 in. thick, forming the bottom of the well.

The thickness of the masonry inclosing the well

is 5 ft. The bottom of the well is 11 ft. below the surface of the lake at extreme low water, and about 16 ft. at extreme high water.

The pumping engines, two in number, are compound condensing, beam and fly-wheel engines, both coupled to one fly-wheel, and so arranged that they can be run together or separately. Bucket and plunger pumps of 40-in. diameter and 84-in. stroke, the plungers being 28-in. diameter, deliver the water into the stand-pipe, 600 ft. west of the engine-house, at an elevation of 85 ft. above the lake. It is 4 ft. in diameter and 130 ft. high, its top being 210 ft. above the lake. It is made of wrought iron; the base is of cast iron, and has 3 openings each of 36-in. diameter.

Two are in use, one for the force-main connection and the other for the main to the reservoir; the third designed for the main for another pair of engines.

The pipe is inclosed in a tower of stone masonry 24 ft. square at base and 175 ft. high; the shaft is circular, and within there is a winding staircase. The force-main to the stand-pipe is of cast iron, 36 in. in diameter and 525 ft. long.

The 30-in. main, 5,700 ft. long from the stand-pipe to the reservoir, crosses the Milwaukee River on a bridge of wrought iron, resting on stone piers and abutments, with four spans; the shore spans of 124 ft. 9 in., the centre spans each of 140 ft. 3 in. The east abutment is 54 ft. and the western 26 ft. long, making the whole length of the bridge 580 ft. The bridge is also intended for traffic, and has a roadway of 17 ft.

The conduit across the bridge is of wrought iron, supported below the roadway on iron girders; from the upper chords it is protected from frost by a wooden box of two thicknesses tongued and grooved. The ends are joined to the cast-iron mains by expansion joints, working in stuffing boxes.

The Kilbourne Park reservoir is on the highest ground in the city, its top line being 150 ft. above the lake. It is in excavation and embankment. The banks were built in layers 9 in. thick, each layer being rolled with a heavy iron roller. The banks are 16 ft. wide on top, with slopes of 1½ to 1 inside and 1¾ to 1 outside. The interior slopes and bottom are covered with clay puddle 2 ft. thick. Over this on the slopes is a layer of 9 in. of broken stone, and upon this a stone paving 15 in. thick in cement mortar. The puddle in the bottom is covered with concrete. The exterior slopes are sodded.

The influent pipe enters on the east side and can be connected directly with the effluent chamber on the west side by a main pipe laid directly across the reservoir, and the city be supplied directly from the stand-pipe.

There are two mains crossing the Milwaukee River, one of 20 and the other of 16 in. diameter. There is also one 20 in., crossing the Menomonee River. These mains all have flexible joints.

A trench, 7 ft. deep, was dredged in the bottom of the river, and the pipes covered with 5 ft. of earth for protection against the shipping, etc.

The smallest size distribution pipe in the city is 6 in., the 30-in mains are not tapped for service pipes; all others are.

The high-service pumping works on the west side were completed and ready for use on May 8, 1878. The high-service engine is a compound direct-acting horizontal engine. The diameter of the low-pressure cylinder is 22¾ in., the diameter of the high-pressure cylinder 10½ in., diameter of pump plungers 8 in., length of stroke is 30½ in.

Their capacity is ¾ million gallons per day.

During the construction of the main works a temporary supply was obtained from the west side of the Milwaukee River by a pump of one and a half million gallons capacity, which pumped into the reservoir after Nov. 3, 1873. This supply was continued until Sept. 14, 1874, when the pumping engines at North Point were started, and have since supplied the city. The population in 1880 was 115,578. The daily consumption in 1879 was 10,604,000 gallons, and there were 86.3 miles of pipe.

The total revenue to Dec. 31, 1879, was $528,676.12. The expenditures for construction to Jan. 1, 1875, were $1,851,591.03.

The expenditure for construction of the high-service works was $31,303.02.

The cost of maintenance for 1879 was $54,805.11. The outstanding bonds on Jan. 1, 1880, amounted to $1,600,000, and the property was valued at $1,975,000.

(TO BE CONTINUED.)

THE CINCINNATI WATER-WORKS REPORT.

The forty-first annual report of the Cincinnati Water-Works is a document of 168 pages, containing valuable details of the condition of the works and the cost of construction and maintenance. The Superintentendent, Mr. A. G. Moore, has given in this volume such a complete statement of everything connected with the works under his charge that the seeker after information regarding the water supply of Cincinnati will not need to look further. The history of the inception and progress of the works, from the earliest time to the present, is admirably detailed by Mr. Thomas J. Bell, the Assistant Superintendent, who has searched the old records, with excellent judgment and to good advantage.

The financial statements are very satisfactory, and exhibit the good effect of careful and intelligent management. The increase of water rents, due to a thorough resurvey and reassessment of the service, is $57,253,89 over the previous year, while at the same time the expenditures have been $23,000,83 less. Mr, Moore recommends a reduction of 15 per cent, in the ordinary water rates, but an increase of 25 per cent. in the rates for the district supplied by the high-service works. The reason assigned for the latter recommendation is that in that district the receipts are less than the expenses of maintenance and interest on cost; and besides, the receipts per mile of pipe are only 30 per cent. of those in the more thickly settled portion of the city. This question of the apportionment of water rents is a complicated one, and is deserving of the serious attention of the managers of water supplies.

Mr. Moore argues in one part of his report that the city should assume the payment of all indebtedness which pertains to increase of capacity, and considers it unfair to compel consumers to pay for additions to the works. That he should then suggest that the population of a district which is yet thinly settled should be made to pay more than the consumers in a populous district does not seem exactly logical or fair.

The experience of the past year in regard to meters is said to be in favor of their use where large quantities of water are consumed, but not in their favor for ordinary house supply, as the muddy water of the Ohio clogs the small sizes.

Eighteen pages of the report are devoted to a sketch of the steps which have been taken for several years past looking toward procuring water from other sources. Mr. Moore advises going ten miles up the river, to what is known as the Markley Farm, which was bought by the city in 1872.

The tables and diagrams given are numerous and valuable.

Table No. 2 giving receipts and expenses for every year since 1839, and table No. 3 showing the population, consumption, pipeage, etc., each year, are very interesting. One great difficulty which seekers for water-works information encounter in the ordinary printed reports of cities, is the absence of definite financial statements. Even in this one of Mr. Bell's the real cost of the works cannot be got at, because there were 10 years, from 1862-72, in which the interest on the water bonds was paid out of general taxation and is omitted from the table. It really does not make any difference who paid it. In a statement of the results of the water-works it ought to be included for every year.

It is a pity that no diagram or statistics appear in the report giving the rate of consumption at different hours of the day.

It is not pleasant to find fault with anything in a document so full of good matter as this is, but it is necessary to call attention to a number of very grave mistakes in Table No. 17, which purports to give statistics of other cities. Such tables are generally quoted far and wide by water committees, boards of health, engineers and others, and it is better that they should be approximately correct. In this table, every item relating to Brooklyn is wrong. New York is not supplied from a lake, and the head of supply is 115 and not 160 ft. It is not correct to say that water is brought to any city by a *viaduct*. Providence has not a gravitation supply. There are other errors which it is not worth while to enumerate. With the exception of this table, the report may be looked upon as almost a model one, in giving statistical information regarding the water-works of a great city.

W. W.

CORRESPONDENCE.

CORRECTION.

IOWA CITY, Ia, May 15, 1881.

EDITOR ENGINEERING NEWS:

I notice an oversight and error in my formula on page 186 of NEWS of May 7th. I must have inadvertently slipped in R_1 instead of $R_2 - R_1$ in one part of the formula. The value of AC is:

$$\frac{(R_2 - R_1)(1 - \cos. \Delta_2) + \frac{1}{2}R_1}{\sin. \Delta}$$

The formula is, however, substantially the same as the one before given and, therefore, the general reasoning is not effected.

Truly yours,
P. H. PHILBRICK.

TAR-COATED IRON SERVICE PIPES.

BOSTON, May 10, 1881.

EDITOR ENGINEERING NEWS:

As "Engineer" "ventures" to say in your paper of 14th inst. that not a single first-class plumber would use wrought-iron pipe, dipped in coal tar, for service pipe, through which to draw water into houses for family use, will you please mention that the engineer of the water-works of a neighboring city did just that thing throughout the city. For a few days the tar produced in the water an unpleasant taste, which soon disappeared; since that time I know of no complaint being made of it. ANOTHER ENGINEER.

AN ANSWER TO "AQUARIUS,"

ST. PAUL, May 14, 1881.

EDITOR ENGINEERING NEWS:

I propose the following solution to the problem of your correspondent "Aquarius" in ENGINEERING NEWS for May 9:

Referring to his diagram, when an opening is made at E, and the water escapes as far as it will, it will stand in B above E by a certain height, which we will call x ft. x is a barometric column measuring the difference between the atmospheric pressure and that within the pipes $B\,C$. It is obvious also that the water in C will stand above that in D by the same height, that is, it will rise in C $\frac{1}{2}x$ ft. above $F\,G$, and fall in D $\frac{1}{2}x$ ft. below $F\,G$. Let h represent the height in feet of a column of an equal to the pressure of the atmosphere=34 ft. about. By the law of Mariotte, the pressure of a given quantity of air is inversely proportional to the volume occupied by it. The volume of the air before making the

orifice is $(4+\frac{1}{2}\pi)=5.57$ ft. of pipe. After making the orifice it is $5.57+3-x-\frac{1}{2}x = 8.57-\frac{3}{2}x$ ft. We must have therefore $5.57\ h = (8.57-\frac{3}{2}x)\ (h-x)$ reducing $x^2 - (5.71+h)\ x = -2\ h$ whence $x = 1.794$. The water will therefore stand in B 1.206 ft. below $F\ G$; in C 0.897 ft. above and in D 0.897 ft. below the same line; 4.206 ft. of pipe will be emptied. J. P. F.

LOCATING A ∨ ON A CURVE.

END OF TRACK, Tex & Pac. R. R.,
May 7, 1881.

EDITOR ENGINEERING NEWS:

Having occasion to put in a 10° ∨ on a 3° mainline, I used the following method of finding the point of curve, and, as it is simple, needs no formula, logarithms, or tables, and may be novel, I send it to you, for the benefit of the craft.

Problem, having a main-line ABC on a 3° curve to run in a 10° ∨ on the *inside* of the curve, and find the points A and C as points of curvature.

Solution: From B measure off the distance BA and BC, equal to the radius of a curve obtained by *subtracting* the curvature of the main-line from that of the ∨, or say $10° - 3° = 7°$; radius of $7° = 819$ ft. A and C are the points sought, and a 10° curve, from these points will tangent to each other at D and since 819 ft. of 3° curve is equal to 24° 34′, or to the angle BEC, this added to 90°, and making 114° 34′, is the amount of curvature in each horn of the ∨.

But if the ∨ is to be run in on the *outside* of the 3° curve, the distance BA and BC is to be found by using the radius of a curve obtained by *adding* the curvature of the main-line to that of the ∨, or $10°+3°=13°$, and radius of $13°=441$ ft.

And since 441 ft. of 3° curve is equal to 13° 12′, angle BEC, this subtracted from 90°, leaving 76° 48′, is the amount of curvature in each horn of the ∨. W. M. JOHNSON.

HOWE TRUSS SPLICE.

RICHMOND, IND., May 14, 1881.

EDITOR ENGINEERING NEWS:

In reply to Mr. E. S. Shaw's last comments on my communication on the subject of a splice for a lower chord in a wooden truss, I have only to say that, in my reply to Mr. Shaw, published in your issue of April 9th can be found full and complete answers to all his interrogatories, if he would only choose to see them. I am sure your readers can easily see that which Mr. Shaw seems so blind to. They also probably see that he is so completely wedded to his "clamp hooks one and one-half and two feet long" that he can see no virtue in any other.

Mr. Shaw may be a bridge carpenter (and perhaps a good one) without understanding the principles involved in designing good bridges (as bridge *carpenters* are not the men that *design* bridges usually), in the same manner as a brick mason may lay up the brick in the walls of a house that an architect has planned; the mason may do his work well and yet he may be no more competent than a hod carrier to judge of the correctness of the principles involved in the design of the house; just so it seems in this case. Mr. Shaw *may* be a good bridge *carpenter* and yet be no more entitled to be termed a competent bridge *designer* than the brick mason above referred to would be entitled to be called an architect.

My communication on the subject of a wooden splice was written for the consideration of *designers* and not *carpenters*.

Designers are sufficiently versed in science to appreciate a scientific analysis, while, on the contrary, as a rule, those who are merely called upon to execute or carry out a design are not competent to judge of the merits of it. Mr. Shaw evidently lays claim to being a bridge carpenter, while he as strenuously asserts that he is *not* a scientific man; therefore, as far as tho scientific merits of the design I have offered are concerned, Mr. Shaw's opinion can have no weight.

I have quoted from the recorded results of a series of practical experiments that have fully verified theoretical deductions. I chose to place them before your readers in response to "C. E. W. D.'s" communication, as it seemed to me they could be appropriately classed under communications on that subject, and would, perhaps, serve "C. E. W. D.'s" purpose, if nothing better was offered. "To this method of procedure" the gentleman from Portland, Maine, objects, but takes good care not to offer anything as a substitute, or even a suggestion that might lead to something better.

What if theory is backed up with practical experiments? What if experiments and analyses do point out defects in "the good old way?" cries Mr. Shaw. That (according to Mr. Shaw's method of reply) should be ignored in the presence of Mr. Shaw's "thirty years' experience with clamp hooks a foot long that shear off."

In writing my communication on the subject of a wooden splice, I of course invited and expected competent criticism from scientific men. Mr. Shaw is careful to tell your readers that he "is not a scientific man;" this was unnecessary; they easily saw that fact, as his communications throughout reveal it; while rushing into print he should give your readers credit for a little discernment.

In replying to Mr. Shaw I have taken more of your space than his communications deserve, as they contain no information that your readers can use in any way whatever.

It is of course patent to your readers that my original communication was written with a view of briefly presenting the results of practical experiments and a theoretic discussion showing the importance of the observance of certain mechanical laws in the design of some classes of work; those for whom my article was written no doubt appreciate my endeavors; if to them I have imparted any fact or idea that may serve to develop other facts, or evolve other and more important ideas, then I am fully satisfied, though some old fogies may not be; to such I shall make no further reply. FRANK C. DORAN, Civil Engineer.

ENGINEERS' SOCIETIES.

WESTERN SOCIETY OF ENGINEERS.

The Western Society of Engineers held a meeting on Tuesday evening, in the rooms of the Western Railway Association, in the Honore Block. Mr. S. G. Greeley presided. Richard Hartford, of Kansas City; J. Scott Jenkins and Thomas N. Boutelle, Clinton, Ia., and Frank Adams, of Dubuque, Ia., made application for membership. Mr. A. W. Wright read a very elaborate paper on "The Best Pavement for Horse Railroads," in which he held that cobble-stone was the most preferable, because the stones were cheap, easily cooled, and less liable to heat than wood. Mr. S. S. Greeley read a paper on "The Best Pavement for City Uses," in which he held that wooden block pavement was being again brought into use in London. He argued that the pavement of the future had not yet been discovered. He would have a foundation of good concrete, six inches thick, made of broken stone and Portland cement. Upon these he would place the pine blocks, and fill in with asphaltum, and cover with a couple of inches of gravel. This gravel should be renewed at least every two years. This was the style of pavement now being laid in London. The great fault of Chicago pavements was their lack of foundation. The joints were too wide apart, and the blocks were thus compelled to bear more than their share of the work. There was not enough paid for paving, and poor material was furnished for what was paid for. He thought that the pavements should be kept in better and proper repair. He would put the gas, water-pipes, and galleries under the sidewalks and crossings, which belonged to the city, and should not be allowed to be used for coal vaults, etc., by private parties. A discussion of the papers followed the reading.

BOSTON SOCIETY OF CIVIL ENGINEERS.

RECORD OF REGULAR MEETING, APRIL, 1881.

WESLEYAN HALL, BOSTON, April, 20, 1881.

A regular meeting of the Boston Society of Civil Engineers was held this evening, President Thomas Doane in the chair, and fifteen members present (Brooks, Cheney, Cunningham, Folsom, Fuller, Howe, Howland, Learned, Manley, McClintock, Mitchell, L. F. Rice, Sampson, Tinkham, Whitwell).

The record of the last meeting was read and approved.

The secretary read the minutes of a meeting of the government, at which it was voted to fix the price of the printed proceedings of the Society at two cents per printed page to non-members and members desiring additional copies.

Mr Franklin M. Miner was elected a member of the Society, and Mr. David H. Andrews was proposed for membership by Messrs. J. E. Cheney and S. E. Tinkham.

The Committee on Uniformity in Datum Planes presented the following report, which was accepted and ordered to be printed:

REPORT OF COMMITTEE ON UNIFORMITY IN DATUM PLANES.

The committee to whom was referred the subject of uniformity in datum planes for levels would respectfully make the following report:

It appears to have been the custom of cities and towns, and also of engineers engaged on public works, to adopt, without any regard to uniformity, some arbitrary datum plane or base to which all levels and heights are referred. Cities and towns located on the seaboard have usually adopted for this plane of reference, so far as the committee have been able to ascertain, either mean high or mean low water, there having been no uniformity of method, however, some adopting one and some the other, according to the caprice of the engineer at the time the datum plane was established. In some cities two systems even have been adopted and are still used.

The base established by the engineers at the time of the construction of the Boston Water-Works (and still used, we understand), was "tide marsh level," or mean high water; but the one subsequently adopted by the first City Engineer, Mr. Chesbrough, for general city purposes (and it is the base used at the present time), was, or rather was intended to be, mean low water. Also, in other cities, the committee understand that different planes of reference for levels have been and are still used by different departments or corporations. This double system of levels in the same locality is very objectionable, and is likely to cause confusion, and may sometimes lead to serious errors.

The committee take this opportunity to protest against any repetition of such a double system where, in the first instance, it can easily be avoided.

The committee do not hesitate to say that, theoretically, some uniform plane of reference for levels would be of great advantage as a means of comparison in different localities; and if such uniformity were to be generally adopted, it appears to them that the *mean level of the sea* would be the most feasible one that could be used for that purpose. Although the mean level of the sea would be the most convenient, if not the only one, that it would be practicable to adopt for a uniform plane of reference, still there are other reasons why mean low water, or extreme low water, or even a lower plane than either, would be found to be preferable in cities and towns located on the seacoast, as it is always desirable to have the base or datum line low enough to avoid the use of minus figures.

In conclusion, the committee would say that after taking the whole subject into consideration, they believe there is no better way of reaching the end, acknowledged by all to be much desired, of uniformity in datum planes for levels, than by the adoption of the *mean level of the sea* for that plane. It will be accompanied by the inconvenience of minus heights, but they believe the mean level of the sea to be the only plane susceptible of being absolutely fixed, and that the *uniformity* and *fixedness* will, on the whole, overbalance the inconvenience.

THOMAS DOANE,
THOS. W. DAVIS,
JOSEPH H. CURTIS, } *Committee.*

BOSTON, April 20, 1881.

The president invited Mr. Mitchell, whom he observed to be present, to express his views, and he responded as follows:

MR. HENRY MITCHELL.—He fully concurred in

the opinion of the committee that the mean level of the sea is the proper datum plane. It is subject to less variation than any other water reference; it is independent of the range of the tide, and essentially so of all the movements of the sun and moon, except *declination*. In our North Atlantic, it is only the declination of the moon that affects the mean level of the sea in any considerable degree, and this amounts to only three inches at Boston. It has been determined, from the long series of observations made by the Coast Survey at the Dry Dock, that with the increase of the moon's declination, whether north or south, the mean level rises. In the Gulf of Mexico, the reverse rule is found to apply, with a maximum change of over six inches.

The unequal pressures of the atmosphere upon different parts of the ocean give rise to changes of mean level, and although it could hardly be expected that the local barometer would be any criterion for this change, it has been pretty well determined that a fall of one inch in the mercurial barometer at Brest is attended by a rise of the mean level of the sea of some sixteen inches; at Liverpool, about ten; and at London, seventeen. On our own coast the change is very small.

The mean level rises as we go up a tidal river, precisely as if this river were tideless; but it does not change as we go through arms of the sea or into bays and lagoons. Different tidal systems have the same mean level, as ascertained at the two extremities of the proposed Cape Cod Canal and on either side of the isthmus separating the Bay of Fundy from the St. Lawrence, or that separating the Atlantic from the Pacific.

While a series of observations extending over a half-year is necessary to determine the elevation of mean high or mean low tide, observations every fifteen minutes for a single calm day at time of mean declination of the moon have been found to give mean level on our coast; and one may feel entire confidence in the average from such very frequent observations, continued from zero to maximum declination of the moon in the stormless month of July. As before said, the sun's declination may be safely neglected.

It would be a good custom to inscribe upon all public buildings some definite elevations above the datum, providing in this way numerous bench marks.

Mr. Mitchell said, in reply to inquiry from the president, that he knew of no public work in the country referred to the mean level of the sea, high or low tide being the usual reference, and that he regarded the action of the committee in this matter as a step forward.

MR. A. H. HOWLAND called attention to certain extra strains in the portal bracing of bridges which are usually provided for, promising at some later date to write out a more complete account.

MR. C. W. FOLSOM gave some account of the methods used in laying out the city of Lawrence, Mass. This was designed to be an example of the best mode of measurement of valuable land (worth from $1 to $2 per square foot at the first sales). The plan adopted for the city (being composed of several rectangles not parallel) was to measure a circumscribing rectangle for each portion, with three 20-foot wooden rods, with microscopic accuracy on lines of level, plumbing down at any change of level the poles being supported on blocks at the ends. From 200 to 1,000 feet a day only was measured.

Chestnut posts 6 feet long, with a 3-foot "T" at bottom, were put in at each street corner on the circumscribing rectangles, and packed with stones; the intermediate street corners (of the same form) being put in by cross alignment.

The error in closing the traverses (averaging say 5,000 feet each) varied from ¼ inch to 2⅜ inches. The *measurements* were assumed as *strictly* accurate, and the right angles were made to conform to the measurements.

This work was compared with the results given in the account of the "Surveying of the New Wards in New York City," in ENGINEERING NEWS for February and March, 1881, where the margin of error allowed was considerably greater; also with some of the first surveys (some years ago) for the newer parts of Brooklyn, N. Y., where the measurements were made with steel tapes on an inclined plane built up from the surface of the ground, the slope of which was ascertained by the leveling instrument.

The general conclusion was drawn that the method with wooden rods was unsurpassed, and was none too good, for lands of sufficient value to warrant its use; but the experience of others was requested on this or rival methods.

Mr. RICE spoke of some very satisfactory measurements obtained by him in the use of the Grumman Chain. This, though not an instrument of absolute precision, was, he thought, the closest approximate to it that was portable and capable of every-day use.

President DOANE described the method adopted by him in running the line of the Hoosac Tunnel, and measuring its length over the mountain.

S. E. TINKHAM, Secretary.

PITTSBURGH SEWERS.

The regular monthly meeting of the Engineers' Society of Western Pennsylvania was held Tuesday evening at Pittsburgh in the Art Association rooms, President Metcalf presiding. The paper on "Pittsburgh's Sewer System," read one month ago by George H. Brown, was discussed at length, Mr. Charles Davis of Allegheny City, Mr. Croes of New York, City Engineer Dempster and others taking part. The attendance was very large, many gentlemen being present who were not engineers, but were attracted to the meeting by the importance of the subject. The following is an account of the proceedings.

The paper on the "Pittsburgh Sewer System" was taken up and discussed as follows:

Mr. Dempster—The great difficulty met with in bettering the sewers has been a lack of inclination of those who would be benefited to pay the cost of sewers. There have been places where cellars were filled with water, and the residents refused to pay for a sewer or even a drain pipe. This is the reason that we have so few sewers. As to the effect of the sewers, they were built under different administrations, generally on the most economical basis and with little regard for what they could do or were intended to do. It was the fault of no one man. As for the present administration, we have not been able to please ourselves, and do not expect to please others. Penurious persons, even when expending money for their own benefit, have always interfered. In any community where an engineer wants to do what he knows he should do, and is unable to carry out his plans, there is always the sharp knife of criticism to run through his work regardless of circumstances.

Mr. Dempster introduced Mr. J. J. R. Croes, a well-known New York engineer, who spoke as follows:

"I only saw the paper a few moments ago, and have not the slightest idea what is in it. If some one more familiar with the subject would speak first, I think it would be better, and probably I might say something later."

Mr. Davis—I am glad some one has taken up this subject. Mr. Brown's paper has many good points, but some things do not accord with my own experience. Thirteen years ago I was compelled to take up the subject in Allegheny. We were a little dumb in this section, and were behind the Western cities. In 1867 I visited Chicago and Brooklyn, where sewer systems had been adopted, and had the matter explained. The first thing to be done is to secure legislation. Pittsburgh is fifty years behind the world in this respect, and will never improve until legislation is obtained. I am not one who favors legislation on all occasions, but is anything more absurd than to build sewers by assessing benefits and damages by a board of viewers, composed of citizens who really do not understand the uses of a sewer, or how it affects the surrounding property? A sewer is intended to carry off the waste of the city. The first thing is to get legislation providing for the expense of constructing the sewers. There are two classes of benefits—one general, one local. The natural water courses, the swamps and low ground, must be looked after, and this is a general benefit; draining private property is a local benefit. In our Allegheny system, Councils in fixing the assessment for a sewer went to work systematically. It was found that a fifteen-inch sewer would drain two blocks, built as densely as any place in Pittsburgh. The cost was then found, and in laying out a sewer afterward, say past a block like the one quoted, the owners were assessed the price of a fifteen-inch sewer, for that sewer would have drained the property. The rate at that time was fixed at two dollars per front foot, and the balance of the cost made up by a millage tax on the entire city, for the whole city is interested in the sewerage. The main sewers were built as Councils pleased to order, the lateral sewers only on petition of the property owners. This plan was started thirteen years ago, and is working to-day, and we have never had a bit of trouble. In Pittsburgh there are localities which will obtain more benefits than others. It would be wrong to assess East End property for a sewer in this vicinity, and the city should be divided into districts. Before you adopt this plan you must get back the money from the odious Board of Viewers system, redistribute it and start with a clean sheet. Mr. Dempster speaks of Pittsburgh's sewer system. You have no system. The city is twenty-two miles square, and the sewers drain one hundred and fifty acres, about one-third of a square mile. Cities do not come ready made, but must grow. The people did not start to make a system of sewers; they were only hunting drains, and may have had mistakes. In regard to the Board of Health report, I think it is very good. They are wrong in many points, but how can we blame them for not comprehending it, when we don't comprehend it ourselves. I think the report shows they were intelligent men, and my only objection is that they did not come to Allegheny for information. As for carrying the sewerage, as Mr. Brown says, away from the city, that's all right, but is the Point away from the city? On the Allegheny side there are three miles of solidly-built town below the Point, and then think of the town along Saw Mill Run. Besides, when the dam is built, the sewers will have to go below it. Let the rain-water run into the river and carry the other away. It is done in other towns. It can be done here. Mr. Brown says that the sewers are too deep, but the best authorities say differently and call for from fifteen to twenty feet below the surface. As to form, the shape he proposes is the best for small sewers, but over four feet the circular is the superior. The best sewered cities in the country are Providence, Brooklyn and Chicago, Providence being the best. Mr. Dempster is not doing what I would do. He has got to make reports; indicate what he wants to do. Of course they will try to take his head off, but he will have to stand it. The more the question is agitated the better it will be for the city.

Mr. Brown wanted to know if Mr. Davis' fifteen-inch sewer would act the same if run from Mt. Ararat. He thought that no rule could be laid down. Branching off, he wanted the ventilation of sewers discussed, and said that it would be as safe to run a ventilator into every grave in the Allegheny cemetery as to let the gas escape from the sewers to the streets.

Mr. Davis answered that with a proper sewer the street man-hole was the best. "If," he said, "you put in an eight-foot sewer to do a two-foot sewer's work, you construct a huge gas trap and nothing else. London has worked all around this and has taken to the man-holes. Mr. Brown is correct in stating that the upper reaches of the sewers contain the most gas, but flap-valves will remedy it. There will be no trouble from ventilation if you start clean. In Allegheny, other things being equal, property on the line of sewers is more valuable, and almost every house has sewer connections, and there is no bad smell. I venture to say that in Pittsburgh there are not 1,500 water-closets connected with the sewers."

Mr. Kent—I notice Mr. Brown says that the Board of Health would be a poor guide for an engineer. In sanitary engineering, the Board of Health, and all other sources must and should be sought by the engineer, who desires to do his duty. If the obnoxious gas in the sewers is met with plenty of fresh oxygen, it will be annihilated, and changed to gases which are harmless. This shows that ventilation is the proper thing. I think that the Board of Health should be composed, partly at least, of men who understand the sanitary question, and it should be the body to decide upon the sewers.

Mr. Davis—I see the Board of Health speaks of the butchers using the sewers to carry off the offal from the slaughter houses. That is done in Butchers' Run, and should be stopped. Sewers are not created for that purpose, but the offal here, as in other cities, should be carted away.

Mr. Brown—If Mr. Kent will read the reports of the Board of Health, he will find that they are full of contradictions, which shows that they were written by unintelligent men.

Mr. Brown grew excited and threw down the glove to Mr. Kent for defending the Board of Health. "I like to hear talk," he said, "but I like a little common sense with it; although I know common sense is a scarce commodity." He took the blackboard and explained his ideas by means of sketches. He fired into the Board of Health, saying that in its proper place it was an excellent body, but wrapping it around with legislative enactments did not make it a judge of a sewer or of sewer gases.

Mr. Kent—All engineers' reports say that compressed gas will force traps.

Mr. Brown—What kind of traps?

Mr. Kent—The ordinary trap.

Mr. Brown—Oh, but I am talking of an extraordinary trap.

Mr. Kent—I say it is better to annihilate the gas than to let it out by trap or confine it in the sewer.

Mr. Brown—But I don't want to annihilate it.

This sort of discussion was kept up for some moments, to the evident amusement of the engineers. Finally, Mr. Kent said that his only point was that engineers do not know all about sewers, and that the Board of Health might know some little that the engineers did not.

Mr. Croes—It appears to me that in Pittsburgh you are trying to put the cart before the horse. You are trying to adopt a system of sewerage before you have the means to carry it out. You have no sewers; you don't know where they are going, or where they are to be obtained. There can be no intelligent discussion of the question until the city has a map made by a competent engineer and a plan devised upon that. Private exertions will not answer. You must bring a pressure to bear on the city officials which will compel them to adopt a system. Judging from what I have heard here to-night, I should say that Pittsburgh, in regard to sewerage, is in a worse condition than are most villages and towns of 20,000 people in this country. As for the Board of Health, it is a very good thing to have doctors on it, but engineers should be on it also. In regard to ventilation, the idea that a sewer should not be ventilated is absurd. The argument has been used that sewer gas cannot blow up a trap; that is not the point. The house trap, generally a siphon, will admit the gas, and doctors say this causes sickness.

Mr. Brown (interrupting)—But I do not mean the ordinary house trap.

Mr. Croes—But you must take things as they are.

Mr. Brown—But that can be—

Mr. Croes—Oh, well, if you are going to reform the whole world.

Mr. Brown subsided, and Mr. Croes finished his remarks in peace.

Mr. Dempster—I propose to answer the criticisms that have been made—some of them justly, some of them otherwise. I will say to Mr. Croes that we have a topographical map of the city in good condition. As for ventilation, they said the South Side sewers caused death because there was no ventilation. A few years ago an epidemic in Allegheny was said to be caused by ventilation. Put those facts together, and what have you? Pittsburgh is not like other cities. We have no long, easy grades. You can't keep sewers full, and there will be spaces in them where gases will generate. This city has more sewers than those that have been brought up. We have a good system if it was carried out, and the city is as well up to the age as it can be. Now as to the assessments on benefits. All property within an area to be drained is benefited and should be assessed as a general benefit, but I don't think an arbitrary price is right, as the cost varies from time to time. I hope to be able to continue this when I have more time at my command.

Mr. Davis, Mr. Croes and others spoke further, but no new points were developed. The society does not meet again until September, and it was decided to take the discussion again at that time, and the meeting adjourned.—*The Times, 18th.*

BOUNDARY MARKS.

LINE BETWEEN THE UNITED STATES AND BRITISH TERRITORY.

The Northern boundary is marked by stone cairns, iron pillars, wood pillars, earth mounds and timber posts. A stone cairn is 7½ ft. by 8 ft., and earth mound 7 ft. by 14 ft., an iron pillar 8 ft. high, 8 in. square at the bottom and 4 in. at the top, timber posts 5 ft. 8 in. square. There are 382 of these marks between the Lake of the Woods and the base of the Rocky Mountains. That portion of the boundary which lies east and west of the Red River valley is marked by cast-iron pillars at even mile intervals. The British placed one every two miles, and the United States one between each British post. Our pillars or markers were made at Detroit, Mich. They are hollow iron castings three-eighths of an inch in thickness, in the form of a truncated pyramid, eight feet high, eight inches square at the bottom and four inches at the top, as before stated. They have at the top a solid pyramidical cap, and at the bottom an octagonal flange one inch in thickness. Upon the opposite faces are cast in letters two inches high, the inscriptions, "Convention of London" and "October 20, 1818." The inscriptions begin about four feet six inches from the base and read upward. The interior of the hollow posts are filled with well-seasoned cedar posts, sawed to fit, and securely spiked through spike holes cast in the pillars for the purpose. The average weight of each pillar, when completed, is eighty-five pounds. The pillars are all set four feet in the ground, with their inscription faces to the north and south, and the earth is well settled and stamped about them.

For the wooden posts well-seasoned logs are selected, and the portion above the ground painted red, to prevent swelling and shrinking. These posts do very well, but the Indians cut them down for fuel, and nothing but iron will last very long. Where the line crosses lakes monuments of stones have been built, the bases being in some places, eighteen feet under water and the tops projecting eight feet above the land surface at high water mark. In forests the line marked by felling the timber a rod wide and clearing the underbrush. The work of cutting through the timbered swamps was very great, but it has been well done, and the boundary distinctly marked by the Commissioners the whole distance from Michigan to Alaska.

ABOUT CORNERS.*

BY FRANCIS HODGMAN, COUNTY SURVEYOR KALAMAZOO COUNTY.

The corners I refer to are not corners in pork or grain, but those points which are located by original land surveys to determine the length and direction of boundary lines. I do not expect to advance anything not already well known to surveyors of experience, but the paper and its discussion may bring out points of value to each of us. What I have to say has more especial reference to a condition of things such as I find in Kalamazoo and adjoining counties, and will have but little bearing in a region where the corners of the original surveys are marked by suitable permanent monuments.

In the region mentioned I find that the United States Government, many years since, caused the boundary lines of townships and sections to be run out, which lines, the law declares, "shall be established as the proper boundary lines of the sections or subdivisions for which they were intended."

At the intersecting points of these boundary lines are the corners, which were designated by certain marks. The same law of Congress declares that these corners "shall be established as the proper corners of the sections or subdivisions of sections which they were intended to designate." All the land has been sold subject to the provisions of this law, and all titles run directly or indirectly to those boundary lines and corners established by the United States survey. See Billingsby *vs.* Bates, 30 Ala., 378; Arvier *vs.* Wallace, 28 Miss., 556; Johnson *vs.* Gresham, 5 Dana (Ky.), 543; 23d Wis., 530. The same principles which apply to the corners and lines of the United States survey I understand also to apply to the corners and lines of all original surveys, such as for village plats, etc., after the land has been sold by them. The fundamental points and lines having been thus legally determined when the first stakes were set, the surveyor who is now called on in the practice of his profession has a two-fold duty to perform. First, he must take, sift and weigh the evidence which tends to show where those original corners were located, and must determine at what precise point the preponderance of evidence indicates them to be. An argument based on false premises is likely to come to a false conclusion. A survey based on a wrong starting point is certain to come to a false ending if it be otherwise accurately performed. Hence the necessity for a correct beginning.

In making original surveys comparatively little importance attaches to the starting point so long as it can be easily identified. The surveyor's work is then almost purely mechanical, running lines in certain directions, and making marks at certain distances. But when the lines and corners have been once established, the surveyor's function changes. He has to determine the location of these original corners before he can even begin the mechanical part of his labors. This is essentially a judicial proceeding, which is often very difficult, and requires a tact and skill in procuring and interpreting evidence bearing on the point, only acquired by long experience and practical work in the field. Thus it may, and often does happen, that one surveyor will fail utterly in finding the marks of an original corner, while another, more apt in discovering the evidences, will strike upon it readily. These evidences are of various kinds, some of which it is the principal aim of this paper to discuss.

I take it that the best possible evidence of the location of an original corner is the monument fixed at that corner when the survey was made. *Vide* McClintock *vs.* Rogers, 11 Ill., 279; also Gratz *vs.* Hoover, 16 Penn. State Rep., 232; 16 Ga., 141. After this come witness trees, fences, distant corners of the same survey, and the testimony of persons.

All these latter kinds of evidence only go to corroborate the first—and may take the place of the first only so far as they may, any of them, seem to have weight in any particular case.

The corners of the United States survey, so far as I have observed, were marked by planting a post or stake in the ground. These stakes had notches cut in them, were squared at the top and set in certain regular positions in the ground. These marks tended to distinguish them from other stakes that might chance to be driven in the ground for any purpose. When trees stood conveniently near, two of them were marked and their directions and distances from the corner were given in the field notes. When no trees were near, a mound was sometimes raised about the post.

It has so happened, in the fifty odd years that have passed since Kalamazoo County was surveyed, that all those posts have so far decayed that I do not remember to have seen a single one of them standing above the surface of the earth. Some of them have been entirely destroyed, but the bottoms of a great many of them still remain, much decayed, but plainly visible when the surface earth is removed from about them.

To find them, careful manipulation is required. The surveyor first determines as nearly as he can from extrinsic evidence the point where the corner post should be looked for. He then with a shovel, spade or hoe, carefully removes the surface earth, a little at a time, being particular not to strike deep at first into the earth at the level as it was when the stake was set. The best and sometimes the sole evidence of a corner has often been destroyed by an ignorant person striking deep into the ground, expecting to find a sound stake, and casting away the decayed wood and filling up the hole of a rotten one without observing it. If the surveyor is looking in the right place, and the earth has not been previously removed, he will soon come upon the object of his search; but he must be careful lest he mistake it. If the soil is a stiff clay, packed hard as in a road or covered with a sward, he will presently find a hole of the size and shape of the stake which made it. This hole will contain the decayed wood of the stake, and a marking pin may be readily thrust to the bottom. By carefully scraping or cutting away the earth from the top, or cutting down at one side of the hole, its size, shape and direction may be readily discovered. Thus it often happens that the position of a corner is as well and satisfactorily marked by the decayed stake as it was by the sound one. It sometimes happens that new stakes have been driven beside the original stake, so that several different ones will be found by the surveyor. He will seldom have any difficulty in deciding which is the true corner by its appearance, for the first stake will be more completely decayed and of a darker color.

As a rule it will be driven deeper and straighter down than the newer stakes. Then, too, the original stakes were generally round, being cut from whole timber, while the later ones were often cut from rails or other split timber, the sharp corners of which can be readily seen in the holes made by them.

There is thus in the appearance of the stakes of the United States survey such peculiarities and such likeness to each other, even when far gone in decay, that the experienced surveyor will be impressed with the appearance of truthfulness pervading them, and will seldom be deceived. This appearance of truthfulness about a stake, which to a surveyor is one of the most valuable parts of the testimony of these silent witnesses, is something that courts and juries can seldom take cognizance of, because, first, they speak in a language that courts and juries do not understand, and, secondly, the evidence is itself destroyed by the surveyor in the taking, and does not come before court or jury in all its freshness, truth and purity. These decayed stakes may be best observed in the light-colored subsoil after the black surface mould has been removed. In sandy soil the cavity made by the stake is gradually filled by the falling sand as the wood decays, but the rotten wood discolors the sand so that where it has not been disturbed, the position, size and shape of the stake may be readily traced. In the black muck

* Read before the Michigan Association of Surveyors and Civil Engineers at meeting held at Lansing in January, 1881

of our marshes and river bottoms it is more difficult to distinguish the stake near the surface, but as the ground is soft and wet the stakes were driven deep, and we may sometimes find in the wet, peaty subsoil the bottom of the stake so perfectly preserved that even the scratches made in the wood by nicks in the axe are plainly to be seen. When the stakes are constantly wet they do not decay.

Next we consider the bearing or witness trees. These are marked and their directions and distances noted in order to assist in finding the corner posts set on the survey. These bearing trees are marked with a blaze and a notch near the ground on the side facing the corner. The measures were taken from this notch. At this time most of the living witness trees have grown to such an extent that only a scar remains in sight, to indicate the point where the notch was cut. In order to get at the notch the superincumbent wood, which is in some cases a foot in thickness, will have to be cut away. It will not often be necessary to do this, as we can come sufficiently near the correct point to find the stake without it. But if the stake has been destroyed, or there are several stakes near, we shall need to be exact and measure from the notch. If the tree has been cut down and a sound stump remains the marks will be easily exposed. Sometimes the mark is gone, but a part of the stump is left. At others the stump is gone, but a dish-like cavity remains in the earth to show where the tree once stood. We can almost always find under and around these cavities places where the large roots have penetrated the subsoil, and thus be able to locate within a foot or so the position of the bole of the tree when standing. In looking for a corner post we may frequently assume, for the time being, that a certain stump or a cavity where a tree had stood was the stump of or the place occupied by a bearing tree. If we then measure the required direction and distance, and find a stake, we may reasonably conclude that our assumption was correct. Such assumptions are frequently of great assistance in finding corners. There may be, and I know there are cases, where the original corner stakes have been destroyed, and can be more nearly restored to their original position by measurements from old stump bottoms or holes in the ground than in any other way. But bearing trees, however good their condition, are by no means infallible witnesses as to the location of a corner. Mistakes in laying down their direction or distance, or both, are not rare. (See McClintock *vs.* Rogers, 11, Ill., 279.) A direction may be given, as north instead of south, east instead of west, or vice versa. The limb may have been wrongly read 64° for 56°. The figures denoting the bearing may have been transposed in setting down, as 53 for 35. So, too, the chain may have been wrongly read, as 48 for 52, the links having been counted from the wrong end. Or they may have counted from the wrong tag, as 48 for 38. Mistakes of the nature of these mentioned are common, so that in working from a bearing tree to find a corner, and not finding the stake at the place indicated in the notes, it will be well to test all these sources of error before giving up the search, for as I have said before, the post planted at the time of the original survey is the best evidence of the corner it was intended to indicate.

I next consider fences in their relations to corners. Potts *vs.* Everhart, 26 Penn. St. Rep., 493. Taken as a whole very little reliance is to be placed on them, although whether any particular fence may be depended on to indicate the true line will depend on the particular circumstances attending that case. In a general and rough way a fence will indicate to the surveyor where to begin looking for his corner. But the practice has been, and still is, common, for the first settlers on a section to clear and fence beyond the line in order to have a clear place on which to set their permanent fence when they get ready to build it. Afterward they forget where the line is and set the new fence where the old one stood. Many fences, too, were set without any survey or any accurate knowledge where the line was and left there to await a convenient time to have the line established. So, too, where the land has been long settled and occupied, it is a common custom for adjoining landowners by consent to set the fence on one side of the true line, there to remain until they were ready to rebuild, the one party to have the use of the land for that time in consideration of clearing out and subduing the old fence row. The original parties frequently sell out or die, and the new owners have no knowledge of the agreement and suppose the fence to be on the true line. For these reasons fences should be looked on with suspicion, unless corroborated by other evidence, and the surveyor should inquire pretty closely into the history of a fence before placing any great reliance on it to determine the position of a corner. It may be the best of evidence, and it may be utterly worthless.

It not unfrequently happens that there are no trustworthy marks near a corner to direct the surveyor in his search for the post or from which to replace it if it be destroyed. In these cases he must visit the nearest corners he can find in each direction (varying with the circumstances, whether it be section corner or quarter post he wishes to find or restore), go through the process of identification with each of them, and then make his point so that it will bear the same relation to these corners as did the original corner post. Many very intelligent gentlemen suppose that if the surveyor can but find one of the corners of the original U. S. survey he can readily determine the position of all the rest from it. They were never more mistaken in their lives. The continual change in the direction of the magnetic needle, the uncertainty as to what its direction was when any particular line was run, the difference in the length of chains, and the difference in the men who use them, introduce so many elements of uncertainty into the operation as to render it one of little value, and not to be resorted to except in the absence of trustworthy evidence nearer at hand.

If it be a section corner you desire to find or replace, and have adjacent quarter posts in each direction to work from, you will not be likely on the one hand to fall more than a rod or two out of the way, and on the other hand will not be likely to come within a foot or two of the right place. This method will assist you in searching for the original stake, and if that be destroyed, and no better evidence presents itself, may be used to determine the point where the corner stake shall be placed. The chief difficulty in applying this method to determine corners arises from the fact that the measurements made on the original surveys were not uniform in length on different sections, and frequently not on different parts of the same section. I have measured sections 22 and 23 on a level prairie, along the line of highways, where no obstacles of any kind interfered to prevent accurate work. I took the greatest possible care in the chaining to have it as accurate as chain work can be done. On the north line of section 22 my chaining tallied exactly with that of the United States survey, viz.: 79.60. On the north line of section 23, my measure was 80.96, that of the United States survey 80.40—a difference of 56 links. Fortunately, all the corners of the original survey on this two miles of line were well preserved, and the distance between quarter post and section corners was uniform on the same section in both sections. But suppose that a part of them had been lost, and it was required to restore the middle section corner (n. e. of 22) from the remaining ones. Omit all consideration of corners, north or south, and there remain four different solutions of the problem, depending on which corners were lost and which preserved. Of these different solutions, one would place the corner 9⅓ links, one 14 links, one 18⅔ links, and one 28 links, all east of the true corner. This is not by any means an extreme instance, as I have observed discrepancies twice as great. It is given simply to show how unreliable is the evidence drawn from distant corners of the U. S. survey.

Lastly, I shall consider the evidence of living persons. (Weaver *vs.* Robinett, 17 Mo., 459; Chapman *vs.* Twitchell, 37 Maine, 59; Dagget *vs.* Wiley, 6 Florida, 482; Lewen *vs.* Smith, 7 Port (Ala.), 428; McCoy *vs.* Galloway, 3 Han. (Ohio), 283; and Stover *vs.* Freeman, 6 Mass., 441). Conceding all men to be equally honest in their evidence, there is a vast deal of difference among them with regard to their habits of observation and their ability to determine localities. Some have an exceedingly acute sense of locality, if we may so call it, and can determine very accurately the position of any object which they have been accustomed to see, while others seem to have little or no capacity of that sort. In twelve years' almost constant practice in making this class of investigations, I have found many men who would describe accurately the sort of monument used to perpetuate a corner, and who would tell you that they could put their foot on the very spot to look for it; but when the trial came I have found but few of them who could locate the point within several feet, unless they had some object near at hand to assist the memory, and even then they would frequently fail.

It may happen where a corner post has been destroyed that its location can be more nearly determined by the testimony of persons who were familiar with it when standing and can testify to its relations to other objects in its vicinity, than in any other way. But the surveyor in receiving this testimony should ascertain as far as possible what are the habits of accurate observation, and the memory of localities possessed by the person testifying, in order to know how much weight to give his testimony.

I have thus far discussed the various kinds of evidence tending to show where original corners were located, upon the theory that, under the conditions as they exist in this State, it is proper matter for surveyors to consider, and that it is an *indispensable preliminary* in most surveys they are called on to make. Unless they determine correctly these starting points, the mechanical work based on them is valueless and worse than valueless.

I am aware that the supreme court of this and other States have decided that the location of corners is a question of facts for courts and juries and not for surveyors to determine. (Stewart *vs.* Carleton). By that I suppose they mean to assert the right of the courts to review or alter the decision of the surveyor until such a time as an acquiescence by the interested parties in his decision shall have taken the case beyond the power of courts or juries to alter. I do *not* suppose that they intend to imply by that decision that no corner or line can be considered as finally determined as a matter of fact on the ground, until it has been passed upon by courts and juries.

If that is what is intended and the people acquiesce in the decision, there will be a fine crop of lawsuits to be harvested before the people will know where their boundary lines are. But I do not suppose the decisions mean any such thing. Probably not more than one corner or line out of a thousand in this State has come before the courts for adjudication. The Supreme Court has had less than a score of cases brought to its notice by reason of the freaks of opinionated surveyors. The nine hundred and ninety-nine cases out of every thousand have been, and probably will continue to be, decided by the people themselves on the authority of the surveyors and not permitted to come within cannon shot of court or jury, while they can avoid it. But even in the cases which are litigated, so far as the question of the location of old corners is concerned, the courts must take the results of the surveyor's investigations as their guide in making up the decision, or else decide a majority of the cases with all the best and most reliable evidence thrown out, for the reason that they cannot get that evidence without the surveyor's intervention.

This being the case, it is of vital importance that surveyors should be competent as well as honest. To render a surveyor competent to act he should be not only well versed in the mathematical theory of surveying, but be a man of practical experience in the field work. He should be familiar with the laws and decisions relative to corners and boundary lines, and the construction of deeds, and should be empowered to administer the necessary oaths and take the sworn testimony of persons offered as witnesses.

The fact that he is such a man should be certified to either by his election as county surveyor or by commission from some properly constituted authority. When corners have been determined on the ground there should be a complete record kept of them at some accessible public place, but more important than anything else, they should be so marked on the ground by everlasting monuments that anybody can find them without mistake and beyond question of their identity.

NOTES.

DIFFERENT VARIETIES OF STEEL.

The following correct definitions of the different varieties of steel by William Metcalf, of the Crescent Steel Works, Pittsburgh, Pa., are published in a circular by the Dexter Spring Company, of Hulton, Pa.

This definition still applies, but in addition the term cast steel applies to all of the products of the crucible, the Bessemer converter and the open-hearth furnace, whether such products are too low in carbon to harden or not. The steels that are not cast steel, are known in the market as blister steel, German steel, shear steel and double shear steel.

Blister steel is made by heating bars of wrought iron, bedded in charcoal, in hermetically sealed chambers. The carbon of the charcoal penetrates the hot iron, converting it into a crystalline mass of crude steel; large blisters rise on the surface of the bars, giving the name blister steel to this product.

Originally the word steel was applied only to iron which contained such quantities of carbon as would cause hardening when the red-hot iron was cocled suddenly.

German steel is blister steel rolled down into bars. It is used mainly for tires and common springs, and is being rapidly superseded by the cheaper grades of cast steel.

Shear steel is made by taking a high heat on blister steel and hammering it thoroughly. Double shear steel is made by cutting up shear steel, piling it, heating it and then hammering again. The best shear steel must be made from the best wrought iron. The shear steels are very useful on account of their toughness, and the ease with which they can be welded to iron, and when of good quality and well worked, they will hold a very fine edge.

Crucible steel is made by melting in a crucible; either blister steel or blister steel and wrought iron; or wrought iron and charcoal; or wrought iron and scrap steel; or, in short, a great variety of mixtures, which depend on the quality of steel to be produced.

Crucible steel can be applied to any purpose for which steel is used. Generally it is better than any other steel, that is to say, crucible steel made by melting blister steel, and tempered to suit by mixing iron of the same grade in the crucible, is always better than German, or shear steel made from the same blister.

Bessemer steel is made by blowing air through melted cast iron, thus burning silicon and carbon out of the cast iron. After the silicon and carbon are burned out, melted spiegeleisen, or ferro-manganese, is added to the charge. The carbon in the spiegel recarbonizes the steel to the desired point, and the manganese unites with and removes the oxygen which the air used leaves in the steel.

Open-hearth steel is made by melting, in a very hot furnace, a charge of pig iron; to this melted iron, which is called the "bath," is added either wrought iron or scrap steel or iron ore, and the whole is kept hot until all is melted. The wrought iron, or scrap, or ore, reduce the carbon and silicon in the bath to such proportions as are desired in the steel.

Bessemer and open-hearth steel are much alike in quality. They are used mainly for rails, boiler plates, ship plates, bridge and other structural purposes, and machinery. The better qualities are also used largely for springs. The best spring steel, like the best tool steel, is simply that which is made from the best material. Quality of material, chemically speaking, being equal, the best spring steel is that which is made from crucible cast steel, as the crucible process is less crude than either of the others.

THE ELECTROPHONE.

An experiment of great importance has just been made at Calais, France. Between that place and Dover, England, conversation has been kept up by means of a new kind of telephone called the electrophone, attached to the telegraph lines between the two places. The listener at Calais was able distinctly to distinguish not only the words of the speaker at the other end, but also to recognize the speaker by his tone of voice. During the time that the conversation was going on the wires were being used for the transmission of messages by telegraph, and that transmission was made without any interruption whatever. The inventor of the electrophone is of opinion that it can be used in connection with an Atlantic cable, and the success of his experiments so far seems to justify his belief.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

The New York Legislature passed the bill in relation to the water supply of Long Island City.

A water company is now proposed for Princeton, N.J., and a prospectus has been issued calling for subscriptions.

The new supply basin of the Boston water-works is at Marlboro and Southboro, and will hold 1,500,000,000 gallons of water, having an area of 800 acres.

Newport having refused to purchase the city water-works from George H. Norman, he will place the stock on the market at $100 per share, the capital to be $500,000.

Mr. E. Graves, City Engineer and Superintendent of water-works at Sandusky, Ohio, has resigned his position to accept one in the employ of the company that owns and operates the Quincy (Ill.) Water-Works.

Fifty thousand dollars worth of water pipe will be laid in Pittsburgh, the Water Committee of that city, on Friday evening the 13th, having authorized the laying of a thirty-inch main on Smithfield street, and other pipe.

The Freeman manufacturing company, N. Adams, are having levels taken at different points on the East Brooklyn street brook, and about 60 feet above their mills, with the intention of building a reservoir for their print-works.

The Collingwood (Ont.) Town Council expect to be able to get a sufficient supply of pure spring water on the mountain at a point 250 feet above the level of the lake, five miles from the center of the town. The cost of reservoir, etc., is estimated at $60,000.

It is announced that the surveys for other water supplies for the city than the Rio S. Pedro, are progressing rapidly. The government is seeking to dispense with the S. Pedro supply, in order to avoid compliance with the decision of the arbitration commission.—*Rio News, April* 24.

The water-works question at Madison, Wis., is now the prominent one in that city. Mr. C. F. Billings, of Milwaukee, who first submitted a proposition to build works and operate them, on account of opposition, has withdrawn his proposition; the Holly Manufacturing Co. are advocating the merits of their system; it will probably be some time before the question is fully settled.

A protest has been sent to the Legislature by the Union League Club, of New York, against a pending bill which authorizes the construction of a new aqueduct by the Commissioner of Public Works. The protestants ask instead that five commissioners be appointed by the Governor and Senate to consider the subject of additional water supply and report to the next Legislature. —*Sanitary Engineer.*

The Asphalted Wrought Iron Pipe Co. have increased their facilities for manufacturing, and having greatly improved their pipe, are now securing the corresponding advantages in increased demand for their product. A new demand for this class of pipe is setting in for use by telegraph and electric light companies, whom the increasing agitation against the use of poles for wires is causing to look for a substitute for underground laying. This pipe, if made for telegraph or electric light purposes, is lined with an extra heavy layer of asphaltum, which makes it a perfect insulator, and being light and cheap its extensive use for those purposes is but a question of time.

Hyde Park, Ill., is about to have new water-works. The engineer has just been ordered to make plans of building, machinery, supply pipes and mains of sufficient size to furnish the entire village with water. This system is to include pipes to South Chicago, Colehour, Irondale, Kensington, Pullman, Riverdale and Grand Crossing, as well as the entire north part of the village. The building proposed is to be of brick and situated on the water-works lot at the foot of Sixty-eighth street. The machinery will be very powerful, of necessity, as the territory to be covered will be nearly as large as that of Chicago, and the citizens of Hyde Park expect all their waste lands to be built up within the next few years. The entire matter will be under charge of J. A. Cole, the Water-Works Engineer.

Denver's well water is very injurious to locomotive boilers. On the Kansas Pacific the locomotives have to be refitted once a year. The water, or the acids which it contains, absolutely destroys the iron, beginning like the wood-worm upon the surface and eating its way through to the cavity. The destroying chemical is applied through the medium of a sediment which settles around the flues in a compact scale so rapid in its formation that it frequently becomes necessary to stop the engines and clean the boilers while in transit. Ordinarily the boilers require a thorough cleaning every two or three days in order to remove this scaly coating, and it sometimes occurs that the cleaning becomes necessary as often as twice in one day. The Kansas Pacific is sinking a deep well in the hope of finding purer water. The inhabitants of Denver do not complain of the destroying acids, it being their custom to mix the water with spir. vin. Gall.

STREETS, DRAINAGE, ETC.

The Board of Trustees of the town of Lake, Ill., have awarded to John Lyons the contract for building a sewer in Wallace street, from Thirty-ninth to Forty-third streets, for $13,803.50; to Malcolm Leith, a contract for constructing a sewer on Root street, from Wallace street to Wentworth avenue, for $13,315.26; to Halloran & Byrne the contract for building a sewer 2½ feet deep from Wallace to State streets, for $3,652; to J. H. Bass & Co., the contract for furnishing the special castings that may be required by the town during the year.

NOISELESS PAVEMENTS.—A bill now before the N. Y. Legislature appropriates $250,000 for repaving Fifth avenue, but requires that stone block pavement shall be used. This bill was originally drawn to provide work for a well-known contractor who did much work under Tweed, but it has been so amended as to strike out a commission clause intended for that purpose, and the sum has been reduced one-half. Some of the Fifth avenue residents are now urging that the bill be further amended to strike out the clause requiring the use of stone blocks for paving. It is claimed that this street, being a street of residences and a favorite drive to the park, should have a noiseless pavement such as are used in Paris, London and Berlin. Commissioner Campbell, in speaking of this subject, said:

"A smooth, noiseless and durable pavement in Fifth avenue would be a boon of the highest value. By reason of its exceptional character as the great central drive to and from Central Park, it calls for exceptional treatment. The cost of a granite pavement laid upon concrete from Washington Square to Fifty-ninth st., would be $217,000, and of a compressed asphalt pavement about the same, and of a Macadam pavement $105,000. The new pavement for the avenue must either be of granite blocks laid upon concrete or a Macadam pavement laid in the best possible manner, or a pavement of asphalt laid upon concrete. The first is objectionable because it is rigid and noisy. The second is comparatively free from noise and affords a good foothold, but wears rapidly, and would at times be muddy and dusty. The third is smooth, noiseless, impervious to water, and, if constructed of the best materials, would, with moderate repairs, endure for years. It is, however, considered more slippery than granite, though it is not found so in Paris and London. With a view of having a test of first-class asphalt pavement I had a block put down in Fifth Avenue, between Twenty-sixth and Twenty-seventh streets. It was laid in July, 1878, and is as perfect as when laid. In order to ascertain the comparative slipperiness of the stone and asphalt pavements, I caused an account to be kept of the number of falls of horses on the asphalt and on the adjoining block of stone pavement. The count was kept for fifty-seven days of the worst season of the year for mud. The average number of horses passing daily was 8,600, and the falls on the asphalt were a fraction less than one fall or part fall each day and on the stone one fall or part fall in two days. I do not thing a fair test can be made, however, on so short a piece of asphalt, as mud is brought on it from the adjacent stone pavement, and horses do not become accustomed to a smooth pavement in so short a distance. In London, observations made by the Chief Engineer for a period of fifty days showed that the distance traveled before an accident occurred on granite was 132 miles, while on asphalt it was 191 miles."

The piece of pavement referred to by Mr. Campbell is laid in front of the Hotel Brunswick, and was put down by the Neuchatel Asphalte Co., of London, whose offices in this city are at 54 Astor House, and the proprietors of other hotels are making efforts to obtain noiseless pavements in front of their hotels.

Henry Bergh, in speaking of the question said: "Among the numerous objections to stone pavements I consider noise the supreme one. The continual strain and wear upon the nervous system occasioned by the tumult of passing vehicles unconsciously impairs the health of mind and body and renders our population easy victims to disease in other forms. Think also of the aggravated torture of the sick and convalescent by this perpetual uproar. Our posterity, I am satisfied, will reluctantly credit the fact that their intelligent forefathers allowed an evil of such magnitude."—*N. Y. Tribune.*

In Austria 65,492 sq. meters of carriage road, sidewalks, etc.; in Hungary 163,235 sq. meters; in Paris a very large area; in Berlin 112,000 sq. meters of carriage road; in London 482,000 sq. yards, of Val de Travers Asphalte, better know as Neuchatel Asphalte, have been laid, and testimonials from the best qualified judges of its efficiency, given after long and severe tests, have been given to the Pavement Company. With the experience gained from London, Paris, Berlin and Vienna, New York can well afford to test the merits of a noiseless pavement in Fifth Avenue.

BRIDGES.

The bill for a bridge at Big Flats, N. Y., has been passed.

The Cornwall-on-Hudson bridge bill has been defeated in the N. Y. Legislature.

The Chesapeake & Ohio Railroad Company proposes to build a bridge across the Ohio River at Huntington.

Gov. Cornell has signed the bill authorizing Catskill, Greene county, to raise money for rebuilding a bridge over Catskil creek.

A project has been advanced for a bridge across Tivoli Hollow, connecting Ten Broeck street with the Van Rensselaer boulevard, Albany.

Surveyors are now busy getting the elevation for the new Albany, N. Y., and Greenbush bridge. They take their calculations from the United States bench on the corner of the Delavan House.

A new railroad bridge will be constructed over the Wissahickon on the Norristown Branch of the Philadelphia & Reading Railroad. It will be built of stone and will have six spans of sixty-five feet each and be wide enough for a double track.

The Mt. Vernon, O., Bridge Company have been awarded the contract of building the Jefferson street bridge at South Bend, Ind. The stipulated amount is $25,443, which, with the $18,000 for the substructure, will bring the expense of the entire bridge up to $43,443.

The Burlington & Missouri people last year built a fine bridge over the Platte River, near Central City, Nebraska. The recent high waters have changed the bed of the river, leaving this structure high and dry, and it forces the company to build a new bridge over the stream where it now runs, some five hundred feet west of the old channel.

WHEELING, West Va., May 18.—This afternoon about 4 o'clock, the main portion of the Baltimore & Ohio

freight bridge over Wheeling Creek, adjoining the passenger depot in this city, suddenly gave way while a heavy freight train was upon it, and the engine tender and two box-cars full of flour were precipitated into the water, 25 feet below.

The Commissioner of Public Works of Chicago, on the 16th, opened the bids for rebuilding the Halsted and Sixteenth street viaduct, as follows: Rust & Coolidge, $23,950; Penn Bridge Works, Philadelphia, $22,700; Massilon (O.) Bridge Company, $19,198; Keystone Bridge Company, Pittsburgh, $24,453; Leighton Bridge and Iron Works, Rochester, N. Y., $16,990. It will be noticed that there is a difference between the highest and lowest bid of nearly $8,000, yet all the concerns are reliable and strong. For building the Kedzie avenue bridge, for which the bids were also opened, the Massilon Bridge Company is the lowest bidder, at $3,765. Both of these lowest bids come within the appropriations made for the purpose.

During the past season Wayne County, Ind., built two bridges over the Whitewater River, both of wrought iron, from the designs of Frank C. Doran, Civil Engineer, Richmond, upon whose plans and specifications all the bidding was done. The county have just let another new bridge to span the Whitewater at Milton; the foundation, masonry and approaches have been let to A. Boden, of Cambridge, Ind., for about $8,000; the superstructure will be let June 8, for all particulars concerning which address the engineer, Frank C. Doran, upon whose plan the bridge is being built.

The superstructure will consist of one span, 210 ft. center to center end pins, trusses will be 28 ft. deep, floor 18 ft. clear. Double intersection; inclined end posts; weight of iron in superstructure about 175,000 lbs.

RAILROADS.

The Minneapolis, Lyndale & Minnetonka Railway Company have closed a contract with Winston Bros., of Minneapolis, for the construction of their line from Minneapolis to Lake Park, on Lake Minnetonka, 20 miles in length, to be completed by Aug. 1, 1881.

SAN FRANCISCO, May 12.—A. A. Robinson, Chief Engineer of the Atchison, Topeka & Santa Fé Railroad, and C. E. Gast, attorney for the same company, with a party of excursionists, arrived from New Mexico this afternoon. It is asserted that Robinson and Gast are arranging for terminal facilities here for their company.

A charter has been issued at the State Department, Penna., to the Tionesta Railroad Company, running from Tionesta, Forest County, to Sheffield, Warren County, a distance of forty-five miles, with a capital of $800,000. J. W. Jones, of the Buffalo, Pittsburgh & Western Railroad is the President of the new corporation, which is designed to tap the new oil fields.

ST. PAUL, Minn., May 13.—A Fargo special to the *Pioneer-Press* says: "Six hundred teams and 2,000 men commenced work to-day on the extension 172 miles west of Bismarck. The engineers estimate that trains will be running to Glendine within six weeks. Grading parties are scattered all along from Glendine for a distance of 140 miles, reaching beyond Miles City. There is no scarcity of supplies, as reported. General Manager Haupt proceeded west this morning."

The St. Louis, Des Moines & Northern Railroad Company intend building 50 or more miles of road this season. Two parties are in the field making surveys, and the location of the line will be complete in a week or two. The line runs northwesterly from Des Moines to Boone, in Boone County; thence it will run north. Surveys are at present made no farther than Boone. It is expected to throw up earth inside the first week of June. E. C. Kinney, of Lorain, Ohio, is chief engineer.

It is expected the Canada & Pacific R. R. will be pushed through to Mattawa in about two months. Mr. McIntyre, of the syndicate, says that the section of road between Rockliffe and Mattawa is irregular, and presents more engineering difficulties than any portion of the entire line of the coming Pacific Railway this side of the Rocky Mountains, excepting about 50 miles in the vicinity of Lake Nepigon. The road for between 20 and 30 miles runs through a country literally paved with bowlders interspersed with hills and ravines, which the ordinary beholder would never once think it possible either to bore through or cross over.

The St. Paul *Pioneer Press* states that it is reported that Manager Hill, of the St. Paul & Manitoba road, contemplates the immediate construction of a road from Sauks Rapids to a point—probably Sunrise—on the St. Paul & Duluth Railroad. It also says that Mr. Hill has a party of surveyors at Kindred, running a line west between the Northern Pacific and its Fargo Southwestern Branch. Messrs. Langdon & Co. have a contract to build 75 miles of this road west from Kindred, also 75 miles north from Casselton to intersect the Grand Forks Branch near Devil's Lane. Langdon & Co. also have a contract to build 75 miles north from Grand Forks, extending the Fargo line of the Company, which is to be pushed to Winnipeg and become the main line. Constructing Engineer Delano will have 400 men at work on the Fargo Southwestern Branch this week.

CITY OF MEXICO, May 18.—The President of the Republic has signed the railroad contract with General Grant. The stipulations are: First—That the line from Mexico passing Puebla, Oaxaca, by Tehuantepec, taking the route along the frontier with the Guatemala branch from Vera Cruz, and Anton to Lizardo the company can build to Ouxetlo, San Christobal and Comitau. Second—The survey and work is to be begun within six months. Third—The road is to be without subsidy, and the company is to have the right of way free, to be allowed importation of articles for construction and conduct of road free of duty during construction and for twenty-five years afterward. Fourth—Tariffs are to be fourteen, ten and seven cents a ton. Fifth—The road is to be the property of the company which shall have the entire control of the management, and may construct it on any gauge, subject to the general railroad law of Mexico. Sixth—The tariff may be raised to ten per cent. of the capital. Seventh—The company shall have full right to mortgage the road and issue stock and bonds. The contract is virtually the same as the one first submitted. Work will be begun at once.

CITY OF MEXICO, May 15.—The Congressional Committee on Public Works has reported favorably on Gen. Grant's railway contract.

RIVERS AND HARBORS.

THOROLD, May 13.—The first water was let into the new canal at half-past eleven o'clock to-day by Mr. Monro, the engineer of the works.

Work has been begun on the Newburyport (Mass.) jetties. M. H. Simpson gave $50,000 toward the work, and Congress appropriated a like amount to begin operations. When completed they will have cost $300,000, according to Gen. Thom's estimate.

The Mississippi River Commission left St. Louis, Mo., on the 5th inst. per steamer Octavia to examine the lower river at high water. The topographic and hydrographic survey was suspended on March 12. The engineers remain in the field and are engagedin mapping the surveys of the past winter. Active work will be resumed again as soon as the river falls enough to bring it within its banks.

VICKSBURG, May 12.—At a session of the Mississippi River Commission for devising plans for the disposition of the $1,000,000 appropriated by the last Congress for the improvement of the Mississippi River, it was decided that the channel at Plum Point, near Osceola, Ark., and the channel opposite Lake Providence, La., be improved. The Commission discussed other works of improvement, but no action was taken. The meeting adjourned until some time in June, the date of which is not determined.

NEW PROJECTS.

The Chicago Belt Railroad is to be built at once.

Work has begun in earnest on the docks of the South Chicago Dock Company, connected with the Chicago & Western Indiana Railroad.

Engineers of the Wabash Railway are surveying through Champaign, Ill., for an extension of the Havana line to a connection with the main road at Sidney.

The Chicago, Burlington & Quincy Company, as well as the Rock Island, is contemplating building new branches into the Northwestern territory, to compete for that trade.

INDIANAPOLIS, May 16.—A meeting of the Cincinnati, Indianapolis, St. Louis & Chicago Railroad Company was held here to-day, at which it was resolved to raise the capital stock from $4,000,000 to $6,000,000, and to employ the additional capital in the building and equipment of a road from Kankakee to Seneca, forming a connection with the Chicago & Rock Island road.

Articles of association of the Illinois and Indiana Railway Company have been filed. Capital stock, $3,000,000; directors, William Burdon, R. B. Caldwell, John B. Thompson, William J. Leddell, E. B. Crum, H. Altman and Jos. M. Hurlbert. The road is to be run through the counties of Dearborn, Ripley, Decatur, Bartholomew, Brown, Monroe, Owen, Green and Sullivan, 160 miles, and is to be narrow-gauge.

NEW YORK, May 16.—Colonel E. W. Cole, of Tennessee, formed to-day in New York probably the largest syndicate ever formed in this country for the purchase of railroad interests. This scheme embraces the establishment of a comprehensive system from the Northwest and Southwest to the Atlantic coast by the purchase of existing lines and the building of new ones. Purchases have already been concluded of the Macon and Brunswick road, of Georgia, the East Tennessee and Virginia system of roads, embracing 619 miles, the Selma, Rome & Dalton, and the Memphis & Charleston roads, covering in all about 1,300 miles. Contracts for the building of several hundred miles will at once be let and the various systems connected. The syndicate has subscribed $16,000,000 of capital. Among the well-known capitalists who may be named in the syndicate are Geo. F. Seney, Samuel Thomas, Calvin S. Brice, E. H. R. Lyman and John S. Martin. Colonel Cole will be made President of the whole system of roads and will have charge of the extension by purchase and building.

The Wabash road has bought fourteen acres of land on the east front of the South Branch of the Chicago River, beginning at a point 600 feet north of what would be Thirty-third street, if that street were opened through, running south to within 600 feet of Thirty-fifth street and extending east to Ullman street, for which they paid $120,000. On this the company will build a grain elevator and construct freight docks along the quarter of a mile river front, as also a slip for the convenience of vessels. The elevator will cost $400,000, and will be built by Mr. George L. Dunlap, whose architect is Mr. J. A. McLennan. The capacity will be 1,500,000 bushels. Work will begin at once. The dimensions of the elevator will be 103 × 344 feet, having an engine and boiler-room 36 × 71½ feet, and the height to the top of the cupola will be 142 feet. There will be 256 bins, 60 feet deep, each holding from 5,000 to 5,500 bushels. Three boilers and a 700 horse-power engine well be employed. There will be 20 elevators, run by friction on the line of shafting, and the machinery in the cupola will be run by a 48-inch rubber belt, and the grain will be distributed throughout the building in the usual manner.

CONTRACTING, MISCELLANEOUS, ETC.

A building costing $15,000 is to be erected in Keokuk for the city library.

On Monday last the architect, D. W. Gibbs, of Toledo, submitted plans for improving the court-house at Norwalk, O., to the Building Committee for their consideration.

The Phœnix Iron Works are kept very busy, employing about 1,500 hands constantly, and will probably have to increase their number to complete the orders on hand.

Plans and specifications for a court-house for Tippecanoe County, Ind., are on file in auditor's office at Lafayette. Sealed bids received up to noon of Monday, May 30, 1881.

It is announced that the engineering corps for the survey of the Rio Claro a S. Carlos do Pinhal railway, of S. Paulo, has been definitely organized under Dr. Antonio Francisco de Paula Souza, as chief engineer.

The government has advertised for sealed tenders on the construction of the Porto Alegre á Uruguayana railway, of Rio Grande do Sul, between Santa Maria da Bocca do Monte and Cacequi—119 kilometers. Tenders will be received until June 15.—*Rio News.*

The Wabash road will spend $1,000,000 on new docks and an elevator at Thirty-third street, Chicago, and the river. The elevator will have a capacity of 1,500,000 bushels, will measure 344 by 103 feet, will have 253 bins to hold from 5,000 to 5,500 bushels each, and will cost $400,000.

Calls for bids to complete the public works are issued. It has been decided to discontinue the services of Mr. Bateman as engineer; not because of any dissatisfaction with him, but to meet the demands of local politicians, a step which is deprecated by the soundest and best informed of our people.—*From the Herald, Buenos Ayres, March* 15.

The contractors for the New York, Chicago & St. Louis R. R. are to receive $9,000,000 for their work between Buffalo and Chicago. All of the work, except that between Tiffin and Fort Wayne has been sublet. The work between Sandusky and Fort Wayne is nearly ready for the rails. It is thought the road will enter New York City by the Delaware, Lackawanna & Western road.

PRICES IN ALBANY, N. Y.—The following proposals were received for excavating, filling, forming, paving and curbing each half of Quail street from Central to Western avenue.

	Excavating per cu. yd.	Filling per cu. yd.	Paving per lin. ft.
P. McQuade	$0.30	$0.08	$3.17
Thomas Reilly	25	....	1.98
J. J. Galoogly	20	19	2.50
Jacob Holler	17	7	1.95
John Ryan	25	....	1.50
James Allen	25	....	1.48

The contract on motion of Mr. Hills was awarded to James Allen.

The following proposals were received for constructing a brick and cement sewer from Broadway to the basin in Quackenbush street, five feet in diameter in the clear:

	Sewer, per ft.	Manholes, each.	Receiving basins, each.	Sewer pipe per ft.
Jacob Holler	$13.00	$65	$117	$1.75
Patrick Murray	9.00	$4 per ft.	100	1.00
Thos. Reilly	7.85	35	100	90
P. McQuade	10.67	45	110	1.30
C. Keenan	11.50	45	85	70
John McDermott	16.40	78	112	1.22
Jas. N. Brady	18.00	115	110	1.50
P. McCarthy	13.95	80	125	1.27
Edward Dillon	12.00	90	125	1.50

The bid of Patrick Murray was thrown out as informal and the contract was awarded to Edward Dillon, who is said to be a relative of ex-Alderman Dillon.

The following proposals were received for constructing a vitrified stoneware pipe drain in Canal street from the sewer in Lark street to the drain in Lexington avenue:

	Per lineal foot.
Jacob Holler	$1.23
Thomas Reilly	1.30
Patrick McQuade	1.33

The contract was awarded to Jacob Holler. The proposals received for constructing a brick and stone drain, 18 inches in the clear, in Myrtle avenue, from a point 90 feet east of Delaware avenue to Dove street, were as follows:

	Per lineal foot.
J. J. Galoogly	$1.00
Jacob Holler	95
Thos. Reilly	1.25
Pat. McQuade	1.35

The contract was awarded to Jacob Holler.

Only one bid was received for the laying of plank walks on the south side of Colonie and south side of Yates streets, and the contract was awarded to John J. Galoogly, at 27 cents per foot each. Mr. Bingham offered a resolution that the gutters on South Pearl street, south of Gansevoort street, be not more than eight inches deep, and that the crown of the street be formed not more than two inches below the top of the curb, and that the sidewalk be graded on a rise not to exceed one-half inch from the curb to the house line. [Adopted.]

The Board then adjourned.—*Albany Evening Journal.*